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THE FRANKLIN INSTITUTE,

OF THE

State of Pennsylvania,

FOR THE

PROMOTION OF THE MECHANIC ARTS.

DEVOTED TO

MECHANICAL AND PHYSICAL SCIENCE, CIVIL ENGINEERING, THE ARTS AND MANUFACTURES, AND THE RECORDING OF AMERICAN AND OTHER PATENTED INVENTIONS.

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JANUARY, 1855.

CIVIL ENGINEERING.

*On the Strength of Locomotive Boilers and the Causes which Lead to Explosion.**† By WILLIAM FAIRBAIRN, F.R.S.

A difference of opinion having arisen between a gentleman high in authority and Mr. Fairbairn, concerning the causes of an accident which took place through the explosion of a locomotive engine at Manchester, on the eastern division of the London and North-Western Railway, a series of experiments was instituted by Mr. Fairbairn, not for the purpose of confuting the arguments of others or confirming his own, but to determine the real causes of the explosion, and to register the observed facts for our future guidance in guarding against such fearful catastrophes.

After a careful examination of the boiler a few hours subsequent to the explosion, one side of the fire-box was found completely severed from the body of the boiler, the interior copper box forced inwards upon the furnace; and with the exception of the cylindrical shell which covers the tubes, the whole of the engine was a complete wreck.

Mr. Ramsbottom, the Locomotive Superintendent, in his Report to the Directors, states that "the engine in question was made by Messrs. Sharp, Roberts & Co., in the year 1840, has been worked at a pressure of 60 lbs. per square inch, and has run in all a distance of 104,723 miles, a great part of which has been either entirely without load, or nearly so. As the cylinders are only 13 inch diameter, it has been for some time too light to work any of our trains; and has therefore been chiefly employed

* Extracted, by permission, from the forthcoming Volume of the 'Transactions' of the British Association for the Advancement of Science.

† From the Lond. Civ. Eng. and Arch's. Jour. June, 1854.

since 1849 in piloting the trains through Standedge tunnel, along with another engine of the same size, which is now at work.

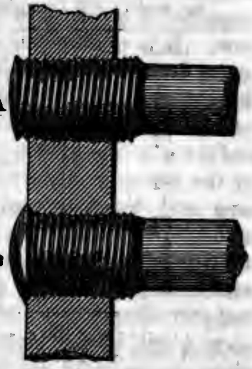
"The fire-box was originally $\frac{7}{16}$-inch thick, and is now a little over $\frac{6}{16}$-inch; and from its excellent condition, might well be supposed (as indeed it was by Mr. Sharp, of the firm of Sharp Brothers & Co., who inspected it a few days after the accident) to have been recently put in new. It is perfectly free from flaw or patch, and would certainly have run at least 100,000 miles. The same may also be said with respect to the outer shell, which is nearly of the original thickness. The engine had been in the repairing shop the three months previous to the accident; and the iron fire-box stays, about which so much has been said, were tested by the hammer in the usual way, and were considered, both by the workmen and the foreman, Wheatley, to be all sound. When originally made, they were $\frac{11}{16}$ths in diameter, and were equal to a strain of at least ten times the force they had to sustain. With the exception of one stay, which was on the top row, the one most reduced from oxidation was half-inch diameter; and supposing the hold on the copper box to have been good, it was capable of resisting a strain of rather more than $6\frac{1}{2}$ times the working pressure, equal, say, to 390 lbs. per square inch. The only point, therefore, which could admit of doubt as to the safety of the boiler, was with respect to the hold which the stays might have in the copper box; but it appears, from experiments since made, and which have been repeated by Mr. Fairbairn, that from the force required to pull some of the old stays out of a copper plate similar to the fire-box, into which they had been screwed by the *old threads only*, and *not riveted*, the boiler could not have burst under a pressure of less than 300 lbs. per square inch. One of the old stays, which had had the thread partially damaged from being ripped out of the copper box by the explosion, was screwed by hand into a copper plate, by the old thread, to a depth equal to the thickness of the fire-box plate, but not riveted, and it required a dead weight of 8204 lbs. to pull it out; and as each stay has to support a surface of 5 inches $\times$ $5\frac{3}{8}$ inches, say 27 square inches only, it follows that a pressure of $8204 \div 27 = 303{\cdot}85$ lbs. per square inch would have been required to strip it. Another stay, which had not been stripped by the explosion, but which was screwed out of the old box, was similarly treated, and required a force of 9184 lbs. to strip it, equal to 340 lbs. per square inch."

Since the experiments here referred to were made, Mr. Fairbairn has repeated them with great care; and taking into account the tensile strength of the stays—in their corroded state—of the side of the fire-box, which to appearance was the first to give way, shows that a force of 380 lbs. upon the square inch would be required to effect rupture; and the results of the experiments on the resistance of stays screwed into the copper fire-box fully confirm those already made by Mr. Ramsbottom. Assuming, therefore, that the end of the screws were riveted, and sound in other respects, we may reasonably conclude that a strain not less than 450 to 500 lbs. upon the square inch would be required to strip the screws, or tear the stays themselves asunder. These facts are founded upon the experiment of the resisting powers of the iron stay screwed into a por-

tion of the copper cut out of the ruptured fire-box, and another experiment of a similar stay first screwed and then riveted, as shown in the annexed engraving.

The stay marked A, $\frac{3}{4}$-inch in diameter, in the first experiment, required a force of 18,260 lbs.=8·1 tons to strip the screw, and draw it out of the copper; and the stay B, of exactly the same dimensions, but riveted over the end, required a force of 24,140 lbs.=10·7 tons before it was dislodged. Taking, therefore, the mean of those experiments, including those of Mr. Ramsbottom, and we arrive at the results given above,—namely, a resisting power of 785 lbs. on the square inch, to burst or produce fracture in the stays and side of the fire-box.

A



B

In locomotive engines of more recent construction, where the stays are thicker and formed into squares of 4 to $4\frac{1}{2}$ inches, the resisting powers will probably be increased to 850 or 900 lbs. on the square inch, that is, seven or eight times the working pressure.

On a careful examination of the fire-box and every other part of the boiler, it was found that the stays and copper were perfect, and that they were able to sustain a pressure much exceeding 207 lbs. upon the square inch, as given in the following table.

In these experiments, the top of the fire-box sank a little, owing to the breakage of a bolt of one of the cross-bars; but the fire-box stays were quite perfect, and to every appearance would have sustained nearly double that pressure. If the fire-box stays had been new and the top well-stayed, it is more than probable that a force from 800 to 900 lbs. on the square inch would have been required to cause rupture.

As much stress has been laid upon the weakness of the stays which unites the flat surface of the boiler to the sides of the fire-box, the following experiments clearly indicate that the fire-box stays are not the weakest parts of a locomotive boiler, and that we have more to fear from the top of the furnace, which under severe pressure is almost invariably the first to give way. Great care should therefore be observed in the construction of this part, as the cross-beams should not only be strong, but the bolts by which the crown of the fire-box is suspended should also be of equal strength, in order that no discrepancy should exist, and that all the parts should be proportioned to a resisting force of at least 500 lbs. on the square inch.

Finding the knowledge with regard to the power of resistance of locomotive boilers to strain exceedingly imperfect, Mr. Fairbairn availed himself of the present opportunity, to determine by actual experiment the laws on which these powers are founded; and for this purpose the Directors of the London and North-Western Railway Company placed in his hands an engine of the same age, constructed by the same makers, and in every respect a fac-simile of that which exploded. This engine was subjected to hydraulic pressure as follows:—

TABLE I.—*Experiment made May 4th,* 1853, *to determine the Resisting Powers of the Fire-box and Exterior Shell of No.* 2 *Engine on the Eastern Division of the London and North-Western Railway.*

Number of pounds on scale.	Weights per sq. inch upon the valve.	Number of pounds on scale.	Weights per sq. inch upon the valve.
Lever	35·0 [1]	5½	132·5
Scale	50·0	6	140·0 [3]
½	57·5	6½	147·5
1	65·0	7	155·0
1½	72·5	7½	162·5
2	80·0	8	170·0 [4]
2½	87·5	8½	177·5
3	95·0	9	185·0
3½	102·5	9½	192·5
4	110·0 [2]	10	200·5
4½	117·5	10½	207·5 [5]
5	125·5		

[1] This engine was the same age, and had run about the same number of miles as the exploded engine. The fire-box was considerably sunk or bulged, and the rivets as well as the stays much weakened. The engine had been at work since 1840.

[2] With this pressure a leakage was observed at some of the joints.

[3] Leakage increased.

[4] Leakage still increasing.

[5] With this pressure one of the bolts of the cross-bar over the fire-box broke, which caused the experiment to be discontinued, as the leakage was greater than the force-pump could supply.

In this experiment, the boiler was furnished with a valve, 1 inch area, and a lever of suitable dimensions. This lever, 15 : 1, gave as the weight upon the valve 35 lbs., and having suspended the scale, which indicated with the lever 50 lbs., the following results were obtained:—

From the above, it is evident that the boiler which led to these experiments could not have burst under a pressure of less than 300 to 350 lbs. upon the square inch, as the failure of a single bolt in one of the cross-bearers above the fire-box, under a pressure of 207 lbs. on the square inch, was not the measure of its strength, but one of those accidental circumstances which is calculated to weaken, but not absolutely destroy its ultimate powers of resistance. This conclusion was arrived at from the fact of finding the upper part of the fire-box in every respect perfect. After the removal of the pressure of 207 lbs. on the square inch, and comparing these experiments with the appearance of the crown of the ruptured fire-box, Mr. Fairbairn is confirmed in the opinion that steam of high elastic force must have been present to cause the disastrous explosion which eventually occurred.

Again referring to the Report, Mr. Ramsbottom states,—"That it has been objected that the steam could not have been raised from 60 lbs. per square inch, the pressure at which the safety-valve was blowing off before being screwed down, to the pressure stated by Mr. Fairbairn, in twenty-five minutes; but although I do not go all the way with Mr. Fairbairn as to the strength of the boiler, I find, from experiments made upon a boiler of somewhat similar dimensions, and placed as nearly as possible under the same circumstances, that the steam was raised from

30 lbs. per square inch to 80 lbs. as shown by Bourdon's steam-gauge according to the following scale, namely,—

	h.	m.	s.		
Safety-valve screwed down	3	1	20	=	30 lbs. per square inch.
" " "	3	2	30	=	35 " " "
" " "	3	3	45	=	40 " " "
" " "	3	5	00	=	45 " " "
" " "	3	6	15	=	50 " " "
" " "	3	7	20	=	55 " " "
" " "	3	8	30	=	60 " " "
" " "	3	9	30	=	65 " " "
" " "	3	10	30	=	70 " " "
" " "	3	11	30	=	75 " " "
" " "	3	12	20	=	80 " " "

These experiments, although perfectly satisfactory as regards the time required to raise the steam (under ordinary circumstances of the engine, standing with the fire lighted, and the usual quantity of coke in the furnace) from 30 up to 80 lbs. on the square inch—it was, nevertheless, considered desirable to repeat them through a still higher scale of pressure and temperature, and to ascertain, not only the exact time, but the ratio of increase, and the corresponding temperature of the steam in the boiler as the pressure progressively increased. For these objects, two delicately constructed thermometers were prepared by Dalgetti, and having adjusted Bourdon's pressure-gauge by a corresponding column of mercury, and an engine having been placed at Mr. Fairbairn's disposal, the following results were obtained :—

Table II.—*Experiment made May 7th,* 1853, *to determine the rate of Increased Pressure, Temperature of Steam, &c., in a Locomotive Engine with the Safety-valve screwed down and the Fire under the Boiler.*

Time.	Pressure.	Temperature, No. 1 gauge.	Temperature, No. 2 gauge.	Mean Temperature.
h. m.		°	°	°
2·44	11·75	243	243	243·00
2·45	14·15	247	246½	246·75
2·46	16·35	251	251	251·00
2·47	19·25	255½	255	255·25
2·48	22·35	260	259½	259·75
2·49	25·75	264	264	264·00
2·50	28·95	268½	268¼	268·37
2·51	32·15	273	273	273·00
2·52	35·75	277	277	277·00
2·53	39·95	282	282	282·00
2·54	44·25	286½	286¼	286·37
2·55	48·35	291	291	291·00
2·56	52·75	295½	295¼	295·37
2·57	57·75	300	300	300·00
2·58	63·75	304¼	304¼	304·25
2·59	68·95	308½	309	308·75
3·00	74·75	313	313	313·00
3·01	80·35	318	317½	317·75
3·02	87·25	322	322	322·00
3·03	93·95	326¼	326	326·12
3·04	101·15	331	331	331·00
3·05	108·75	335½	335¾	335·62
3·06	111·75	—	—	—[1]

[1] This experiment was lost, the thermometers not indicating a higher temperature.

Let us now endeavor from this table to discover the law expressing the relation between the time and pressure, or between the time and temperature.* The observations being made at intervals of one minute of time, and the furnace being maintained at the same intensity, it may be presumed that the quantity of heat communicated to the water was uniform, or that there were equal quantities of absolute heat communicated to the boiler in equal times. The column of pressures gives the successive augmentations of pressure at equal intervals, and the column of temperature gives the corresponding augmentations of heat as indicated by the thermometer. The column of pressures shows that the increments of pressure, in equal intervals of time, increase with the temperature; thus at or near 260° the average increment of pressure is at the rate of 3·1 lbs. per minute; at or near 282°, it is 5·4 lbs. per minute; at or near 326°, it is 7·1 lbs. per minute. Mr. Ramsbottom's table of experiments indicates a similar result; thus at or near 268° the average increment of pressure is at the rate of 4 lbs., whereas, at or near 304° it is at the rate of 5 lbs. per minute. The law, therefore, expressing the relation of time and pressure does not appear to admit of assuming a simple form. But the case is different with respect to the law expressing the relation of time and temperature. Thus if T=temperature in degrees, and t=the time in minutes at which this temperature is observed, estimated from the commencement of the experiments, then

$$T=a\times t+b \quad . \quad . \quad . \quad . \quad (1)$$

will give the relation between T and t with great precision where a and b are constants, whose values, derived from these experiments, are

$$a=4{\cdot}44 \text{ and } b=-486.$$

For example, let t=166, then $T=4{\cdot}44\times166-486=251°$, which exactly corresponds with the tabular value. Again, let t=180, then $T=4{\cdot}44\times180-486=313°{\cdot}2$; in this case the tabular value is 313°. Again, let t=185, then $T=4{\cdot}44\times185-486=335°{\cdot}4$; in this case the tabular value is 335°·6. From this formula we find

$$t=\frac{T+486}{4{\cdot}44} \quad . \quad . \quad . \quad . \quad (2)$$

If t=the number of minutes which elapse between the temperatures T and T′, then we find from 29 (1,)

$$T'-T=4{\cdot}44\,t'; \quad . \quad . \quad . \quad . \quad (3)$$

which shows that *the temperature increases with the time;* and presuming that the heat of the furnace remained constant, this formula also shows that *equal increments of absolute heat produce equal increments of sensible temperature as indicated by the thermometer.*

To determine the time, estimated from a given pressure, at which the boiler would burst.—

1st. Let the given pressure be that of the atmosphere, and let the boiler be able to sustain 240 lbs. pressure per square inch. From an experimental table of pressures and temperatures, we find 240 lbs. pres-

* The mathematical analysis of this question was supplied by Mr. Tate.

sure to correspond to 403° temperature, and 15 lbs. pressure to 212° temperature; hence we have by formula (3,)

$$t' = \frac{403 - 212}{4 \cdot 44} = 43 \text{ minutes,}$$

which is the time in which the boiler would burst, estimated from the time at which the water begins to boil.

2d. Let the given pressure be 60 lbs. per square inch, and the boiler-pressure 240 lbs. per square inch, then

$$t' = \frac{403 - 296}{4 \cdot 44} = 24 \cdot 1 \text{ minutes.}$$

3d. Let the given pressure be 60 lbs. per square inch, and the boiler-pressure 300 lbs., then

$$t' = \frac{422 - 296}{4 \cdot 44} = 28 \text{ minutes,}$$

which is nearly the time in which the boiler experimented upon would burst.

These facts appear to be sufficiently conclusive to enable us to judge of the dangers to which people expose themselves under circumstances where the necessary precautions are not taken for allowing the steam thus generated with fire under the boiler to escape. The great majority of accidents of this kind have arisen during the time the engines are standing, probably with the safety-valve fastened and a brisk fire under the boiler. How very often do we find this to be the case in tracing the causes of these melancholy and unfortunate occurrences!

(To be Continued.)

For the Journal of the Franklin Institute.

Description of Kensington "Water Works." By Washington Jones.

These works, commenced in the year 1849, under the superintendence of Mr. J. Singerly, were intended to supply the inhabitants of the District of Kensington with water from the river Delaware.

The engine and pump-house is situated on the river, at the foot of Wood Street, in the northern part of the District. It is fifty feet wide by seventy feet long; built of bricks in a neat, substantial manner, with rustic work at the angles; the foundation walls are based upon a solid rock, that lies about eighteen feet below the surface of the ground.

The two reservoirs are situated between Sixth and Seventh Streets, and north of Lehigh Avenue, at a distance, measured on the line of the ascending main, of about thirteen thousand three hundred feet from the pump-house, and at an elevation of one hundred and twenty feet above the level of mean tide.

The bottoms and sides are covered in the usual manner, with bricks set on a bed of well rammed clay puddle. Each reservoir is, on the bottom, one hundred and sixty-one feet wide by two hundred and ninety-six feet nine inches long. The angle of inner slope 35° from a vertical line. The content of each, when filled to a height of twelve feet above

the bottom, is 4,642,026 standard gallons, or, about 100 gallons for each inhabitant of the District.

There are two pumps and engines, with two setts of boilers, so arranged that either engine can be supplied with steam from either sett. Engine and pump, No. 1, was built by Messrs. Brock & Andrews, to designs made from the specifications furnished them by the committee, appointed by the Commissioners of the District from their body to superintend, in conjunction with their engineer, the construction of the works. The engine is non-condensing, with a cylinder 30 inches diameter, 6 feet stroke, lying in a horizontal position, and fitted with balance puppet valves. The boilers built for this engine are six in number, 42 inches diameter, and 40 feet long: and supply steam of 40 pounds pressure per square inch, for ten revolutions of the engine per minute.

The pump barrel is 18 inches diameter, 6 feet stroke, and lies in a horizontal position, about eighteen feet below the steam cylinder, and eight feet below mean tide. It is double acting, with valve boxes similar to those in use at Fairmount Water Works, originally designed by the late Frederick Graff, C. E. Motion is given to the pump piston by the vibrations of a vertical lever beam, whose upper and lower ends are respectively attached by links to the cross-head of the cylinder and that of the pump. The specifications required: "Two receiving and two discharging valves, which will be placed at an angle of 45°; each sett will be divided into four divisions, and of equal or larger capacity than the area of the pump barrel." This condition compelled the valve boxes to be made unusually large. Their dimensions were, three feet ten inches wide, two feet ten inches deep, and nine feet long. Thickness of metal, one and three-quarter inches. So much flat surface was presented to the pressure of the water, with an insufficiency of metal to resist it, that the boxes bursted, soon after being put in operation, of course disabling the whole works. A committee of consulting engineers, after inspection, advised several important alterations and additions to the pumping apparatus and engine, which were made under the superintendence of Wm. E. Morris, C. E. The banks of the reservoir showed symptoms of weakness, and were strengthened in the necessary parts. The subsequent action of the engine has abundantly proved that the changes and additions were judicious and necessary. The consumption of fuel required to keep engine, No. 1, supplied with steam is not positively known, as there have been no conveniences at hand for testing it; but, it is stated by Mr. J. J. Dehaven, Chief Engineer, in his official report to the Commissioners of the District, to be eleven tons in twenty-four hours, when engine averages ten double strokes per minute, carrying steam for the whole stroke, which shows the evaporative efficiency of the boilers to be 4·24 pounds of water, (first warmed by passing through a heater, forming part of the exhaust pipe of engine) converted into steam of 40 pounds pressure, by the consumption of one pound of anthracite coal.

No convenient opportunity has offered for proving the amount of water pumped into the basins, by engine No. 1, in a given time, but, by taking the result of the trial made on engine, No. 2, which gives the amount of water raised, 70·6 per cent. of the space displacement of piston, making, at ten strokes per minute, a total of 1,550,442 standard

gallons raised in twenty-four hours by an expenditure of eleven tons of coal, or about 62·9 gallons, or 522 pounds of water, raised 112 feet high, at a velocity of 120 feet per minute, for each pound of coal consumed.

Engine, No. 2, was built by Messrs. Reaney, Neaffie & Co., and put in operation, August, 1852. It is of the condensing type, and has a cylinder 42 inches diameter, 6 feet stroke, standing in a vertical position. It is fitted with balance puppet valves. The steam is cut off after the piston has traveled seven-eighths of its stroke. The piston rod passes through the top and bottom of the cylinder; its upper end is attached to a lever beam, which gives motion to a shaft for working the valve gear, and carrying a fly wheel of just sufficient weight to make the engine pass the centres without hesitation. The lower end of the piston rod is attached to the horizontal arm of a right angled bell crank, whose vertical arm is connected to the pump piston rod. The pumping apparatus is the same as that of No. 1, except the pump barrel, which is $19\frac{7}{16}$ inches diameter, or, one inch seven-sixteenths larger.

Both setts of pumping apparatus have upon their discharging pipes, an air vessel whose content is 230 cubic feet; there is also one upon the supply pipe, containing 30 cubic feet. In the absence of experiment, in this case, it cannot be determined whether the latter vessels are of use or not. The experiment of Messrs. Kirchweger & Prussman (*vide Journ. of Franklin Institute*, Third Series, vol. xxiv, p. 367,) show, that at high speeds of pump piston, the application of an air vessel to the supply pipe of a pump, is of positive benefit; but, in this case, the speed of the piston is not high, averaging 144 feet per minute; the supply pipe is more than one-half larger in diameter than the pump barrel; the pump is about eight feet below mean tide, which head is sufficient, after a liberal allowance has been made for friction in the pipe, to fill the vacuum made by the pump piston, when moving at a higher rate of speed than obtains in ordinary times. These advantages tend to show, that the air vessels on the supply pipes might be dispensed with, without prejudice, and, again, the coefficient of effect is not greater than where such an air vessel is not used.

In September, 1852, one of the reservoirs having been emptied, the Watering Committee instructed the engineer to fill it with pump and engine, No. 2, and keep an account of the time occupied in raising the surface of the water twelve feet above the bottom, when the content is, as previously stated, 4,642,026 gallons. The evaporation from such a large suface of water, and the absorption by the brick lining of the basin, would be probably compensated for by dews and rain; but, as no account of the weather was kept, extreme accuracy not being required, the amount of water raised may be considered as neither increased nor diminished by incidental causes. The time occupied in filling was, 60 hours; number of double strokes, marked by a register, 36,900.

This gives for each double stroke nearly 126 gallons. The space displacement of piston is nearly 178·5 gallons; the actual effect of the pump is, therefore, not quite 70·6 per cent. of its capacity, or about the usual per centage. No account was kept of the consumption of fuel, but, from the official report of the engineer, for the month of November, 1853, is taken the following account of the consumption of coal, running time,

number of revolutions, and amount of water pumped into the basin by No. 2.

Total tons of coal consumed, . .	120
Number of hours running time, including stoppages for oiling, cleaning, &c., 528, or . . .	22 days.
Total revolutions, . . .	389,919
Total gallons pumped into basin, estimating the quantity raised each double stroke at 126 gallons, as determined by the trial in September, 1852, . . .	49,129,794

This gives as the actual effect realized by the expenditure of one pound of coal 182·77 standard gallons, or 1526 pounds of water raised 112 feet high, with a velocity of 164·5 feet per minute.

The evaporative efficiency of the boiler is about the same as in other boilers of its type, 'flue and rising return flue,' 8·75 pounds of water evaporated by one pound of coal. The feed water being supplied from the hot well of the engine.

When No. 2 performs the same work, with steam of ten pounds supplied by the cylinder boilers, there is required a consumption of eight tons of coal, which gives 5·98 pounds of water evaporated by one pound of coal: an increased effect which must be attributed to the slower and more perfect combustion of the fuel, as the fires need not be urged, but the contrary, when steam of but ten pounds is required.

Engine, No. 2, has been kept running at a speed of eighteen revolutions per minute, when the consumption of water from the basin has been so much greater than ordinary as to require it. At that speed the valves do not jar much more than when making twelve beats per minute, which is attributed to their construction, the part farthest from the hinge being made very heavy, to insure prompt closing before the return stroke of the pump piston permits the reflux of the water to close the valve with a blow; and, to the very large size of the air vessel on the ascending main, its content being thirty-four cubic feet (or nearly three times the capacity of the air pump barrel) of air, at a density due to the pressure resulting from the effort of the column of water in the main when moving at that velocity. The pressure, as determined by one of Bourdon's gauges attached to the main, per square inch of pump piston, when moving at different velocities, varies from the commencement of stroke to half stroke,

63 to 68	pounds	at a	speed	of 120	feet	per	minute.
70 to 75	"	"	"	156	"	"	"
77 to 80	"	"	"	168	"	"	"

with 11 feet 3 inches of water in the basins. The speed of the water in main, being inversely as the diameters of the pump and main, will be 16¼ per cent. greater than the speed of that in the pump. When at the speed of 156 feet per minute, which is greater than that intended for ordinary service, the throttle valve was partially closed, effecting a reduction of, say 1·5 pounds below the boiler pressure of 10 pounds, making the initial cylinder pressure 8·5 pounds, which is farther reduced by expanding one-eighth, to a mean pressure of 8·4 pounds. Vacuum steam by gauge, 13 pounds, total pressure per square inch in cylinder=21·4 pounds.

The pressure per square inch on cylinder piston necessary to keep the pump piston at the above speed is $\frac{72 \cdot 5 \times 19 \cdot 4375^2}{42^2} = 15 \cdot 49$, subtracting this from 21·4 there remains 5·91 pounds, which is absorbed by the friction of the pump and engine and the load on the air pump.

The pressure per square inch on pump piston due to the head of water 120—8=112 feet is nearly 48·5 pounds: average pressure at 156 feet per minute 72·5 pounds; difference 24 pounds; equivalent to an additional head of nearly 55·5 feet, or almost one-half more than the actual height to which the water is raised. This proves that about one-third of the effective engine power is used in overcoming the friction and inertia of the water column. A loss that is occasioned by its devious course, two right angled bends, in addition to those of a small angle, caused by the inequalities of the ground through which the main is laid, at a uniform depth below the surface, occurring in the passage to the basins, and by its great length, over two and a half miles.

During the very warm weather of July last, one pump would not raise enough water to supply the increased demand, unless the speed of the engines was made greater than that considered prudent, and for which they were designed, twelve double strokes per minute.

To meet the demand, both engines were set to work, each averaging ten revolutions per minute, which speed was found adequate to keep up the supply.

Both pumps discharged into one ascending main of 18 inches diameter, which bore the increased pressure due to the increased velocity of the water, proving it to be of sufficient strength for the ordinary strain to which it is subjected.

For the Journal of the Franklin Institute.

Considerations Respecting the Hoosac Tunnel. By EDWARD W. SERRELL, Civ. Eng.

The State of Massachusetts has granted a loan of $2,000,000, to the Troy and Greenfield Railroad Co. on certain conditions, to aid in the construction of the tunnel through the Hoosac Mountains; the connexion to be formed by means of this work between Boston and the West, is considered by its projectors and friends of very great importance, and by means of the State loan, recently obtained, it is proposed to re-commence operations on that part of the line, including the mountain section.

Irrespective of its importance in a commercial or financial point of view, let us consider it as an engineering enterprise.

The entire length of the tunnel is to be 24,100 feet, or 340 feet over four miles and a half. The summit of the mountain is about eight hundred feet above the grade line, and averages about six hundred feet over the tunnel.

The mountain is, according to Professor Hitchcock, primitive rock, of mica slate, nearly all the way through, with some lime and iron on the western slope.

The strata is nearly vertical, or inclined only from four to ten degrees.

The line of the direction of the railroad, crosses the strata nearly at right angles.

It is proposed to build the tunnel for a double track railroad.

In order that there may be a proper drainage, it is proposed to make a slightly ascending grade from either end to the centre.

To lay out this work and get it ready for the contractors, requires merely the careful use of properly adjusted, accurate instruments; but this is of itself, a task of no ordinary consequence.

The best plan to be adopted in constructing the work, is of more importance, and involves questions not ordinarily met with in railroad engineering.

Whether the tunnel shall be worked from both ends only, or whether shafts shall be employed, has yet to be determined. If shafts are used, then all the contingencies of pumping and hoisting have to be considered, and whether shafts are, or are not used, how to effect a proper ventilation, during the construction and permanently after the tunnel is built and is in use, is a question of the greatest consequence.

Then, too, it is no easy matter to determine what method shall be adopted to make the excavations after the plan is adopted on which they are to be made, whether by shafts or without them, and these questions of necessity run into and become one "of the *time* to be employed in doing the work."

Wilson's machinery, which was constructed before the loan was obtained from the State, and was tried at the easterly side of the mountain, is said to be defective in many particulars, but the inventor has modifications of his plans with which he confidently expects to be able to overcome all the difficulties. This machine is intended to cut a circular section, and leave a core in the middle, to be removed by wedges or blasting. Corcoran's machine cuts a circular tunnel, removing the whole face of the section; this machine acts by reciprocal movements; Wilson's by rotary motion.

Besides these, Gardner has invented a system of drills, which has merit in their combination. Browne, and others, have contrived various methods of applying ordinary drills, and still another plan is advocated, that of boring by the combustion of gases, and the application of electricity.

By some of these machines, or by something else not yet contrived, or by the old fashioned method of drilling by hand and blasting, the excavations have to be made.

The profession and the public will look with interest upon the plans adopted and the results arrived at.

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*Railway Signals from China.**

Captain J. Norton described some methods of establishing communications between the guard of a railway train and the engine driver, one of which he exhibited that had been brought from China, and used there as a signal for different purposes. It consisted of a metal whistle fixed to a short stick, which when thrown through the air made a shrill sound.

* From the Civil Engineer and Architect's Journal, November, 1854.

The faster it is propelled, the louder the noise; and Captain Norton said the most effective way of using it for railway signals is to push the stick into the barrel of a pistol charged with gunpowder, and to fire it over the engine driver's head. In this manner he had, on several occasions, tried its efficacy, for when the train was going at full speed, he had sent the missile whistling through the air, and obtained an immediate response from the steam whistle, indicating that the engine-driver had heard it.

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*Results of some recent Investigations of M. Vicat upon the Destructive Action which Sea Water exerts on the Silicates known in the Arts as Hydraulic Mortars, Cements, and Puozzolanas.**

M. Vicat, to whom we are so much indebted for our knowledge of the preparation of cements, has recently presented to the French Academy of Sciences, the following *résumé* of the chief general results to which a very long course of experiments upon that very important subject, the durability of cements in marine constructions, has led him:—

1. That the double hydrated silicates of lime and alumina, just mentioned, are very unstable compounds.

2. That pure water when poured upon all of them in the state of as fine powder as can be produced by ordinary means, no matter what might be their age or hardness, will dissolve a portion of their lime, provided they have not been in any way, or at least to a very slight degree, exposed to the action of carbonic acid.

3. That if, under the same circumstances, a very dilute solution of sulphate of magnesia or Epsom salt be substituted for the pure water, the greater part, and often the whole, of the lime existing as silicates passes into the condition of sulphate. If any carbonic acid had previously acted upon it, the carbonate of lime thus formed is not decomposed by the sulphate of magnesia.

4. That all puozzolanas, no matter what may be their ages, require for their complete saturation, a very much smaller quantity of lime than is added in practice, especially when we take into account their very imperfect state of division from the rough way in which they are usually prepared.

5. That the affinity of carbonic acid for the lime in combination in these various silicates is so strong, that it is possible, with the aid of a little moisture, to completely neutralize it, wherever it can penetrate, and thus leave all the other constituents of the cement, whether in combination or not among themselves, as mere mixtures in the mass.

It follows, from these results, that sea water will destroy every cement, mortar, or puozzolana, if it can penetrate into the mass immersed in it. As, however, certain of these compounds are perfectly durable when constantly immersed in sea water, they cannot have been penetrated by it. Its penetration has been prevented by the surfaces, and the source of this inability to penetrate, is chiefly caused by a superficial coating of carbonate of lime, which has formed either anteriorly or posteriorly to their immersion, and which in time augments in thickness. The effect

* From the London Artizan, August, 1854.

of a kind of cementation produced by the decomposition of the sulphate of magnesia, of the sea water, and the deposition of carbonate of magnesia in the superficial tissue of the mass, and the formation of incrustations and of submarine vegetation, contributes also to this impermeability. But all such superficial impermeable coatings, are not attached with the same force to the mass which they envelop. The differences which have been observed in this respect depend in some cases upon the chemical constitution, and upon the peculiar cohesion of the silicates, and in others upon their submarine situation, relative to the action upon the waves and the rolling or dashing of shingle upon them. Hence the differences which have been observed by engineers in the durability of concretes of which such silicates form the gange.

M. Vicat is preparing a memoir, in which he will attempt to explain the nature of the chemical constitution of those silicates which are durable, compared with those which are not; and which will show the preponderating influence of silica in such phenomena. He will also point out a simple and certain method of classifying all such compounds, as to their fitness or not for submarine constructions, and thus will assist in very much shortening the time necessary at present for testing them by exposure to the action of sea water. From the great practical importance of the subject, and the attention at present directed to it, this memoir will be looked forward to with considerable interest.

Comptes Rendus, January, 1854.

For the Journal of the Franklin Institute.

A new Method of Proportioning Stone Bridges. By John C. Trautwine, Civil Eng., Philadelphia.

I respectfully submit to the profession, the following method of determining the proportions of stone bridges. At the risk of being considered egotistic, I will venture to remark, that in my opinion, it possesses merit, not only *as a practical guide* to the unscientific mason; but also as being equally dependable with the results of any of the generally received theories.

It will be found to give proportionably thicker arches and abutments to small spans than to large ones. The necessity for this is well known to those of the profession who have studied the subject.

The method was devised by myself several years ago, while an assistant engineer, and before I had sufficient experience to warrant me in presenting it as a reliable contribution to engineering practice.

It applies alike to arches of any size or shape whatever, whether semicircular, segmental, elliptic, catenary, gothic, parabolic, &c., &c., as well as to every height of abutment.

The Rule is as follows: First, For the thickness, a, b, of the arch, or in other words, the depth of arch-stones in feet, take one-third the square-root of the span, c, d, in feet.

Next, draw the arch to a scale, with the thickness thus obtained; and add to it $c\ s$, and $d\ t$, the heights of the abutments; also, $s\ r$, and $t\ e$,

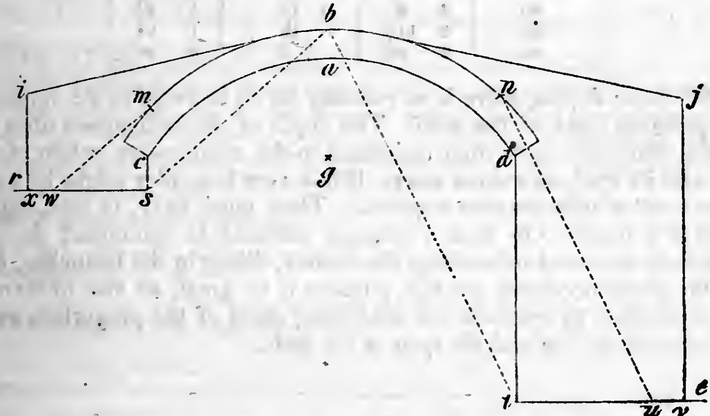
their base lines. Then, from the top of the arch, *b*, with an opening of the dividers equal to *one-half* the span *c d*, lay off *b m* and *b n*.

Next, draw *m w* parallel to *b s*; and *n u* parallel to *b t*.

Make *w x* and *u v*, each, equal to one-tenth part of the rise *a g*, added to one-tenth of the *half span c g*.

Then will *s x* and *t v* be the bases of the abutments, or of the abutment-piers, as the case may be.

Lastly, for the backs of the abutments, draw *x i* and *v j* to the height of *m* and *n*; and for the haunches, draw lines from *i* and *j* towards *b*, touching the arch as high as possible.



Above these lines the space will generally be filled with earth for the roadway; but if preferred, it may be carried up with solid masonry, or parallel walls.

A few of the lower courses of masonry should project so as to form feet for the abutments; and then, *the level of the top of the upper step or offset, should be assumed as the base line of the abutment* in drawing the figure, instead of the bottom of the foundation pit.

The rule remains the same in all particulars, for all arches whatever.

With first class materials and workmanship, *w x* and *u v* may be reduced slightly; but I regard the rule as it stands, better adapted to ordinary practice. Other trifling modifications suited to peculiar circumstances, will suggest themselves to an experienced engineer. The young practitioner will, however, bear in mind, that if his stone bridges are too slight, a few years of heavy railroad traffic will *shake them to pieces*, although they may stand very well for a while.

The arch of equilibrium for bridges, which forms the chief topic of discussion in theoretical treatises on that subject, has no existence in point of fact; and in small bridges, where a heavy load, as for instance a first class locomotive, bears a large proportion to the weight of the bridge itself, the principle utterly fails to be applicable. The smaller the bridge, the larger in proportion must be its parts; but to what extent we must proceed in adjusting them on this basis, depends upon the results of experience. I trust that my Rule will be found not to conflict with these; but to afford a really valuable aid to this important branch of engineering.

I subjoin a table of depths of arch-stones, calculated by this Rule.

Span of arch in Feet.	Depth of Arch-stones	Span of arch in Feet.	Depth of Arch-stones
	Ft. Ins.		Ft. Ins.
200	4 8½	60	2 7
180	4 5¾	50	2 4¼
160	4 2¾	40	2 1¼
140	3 11¼	30	1 10
120	3 7¾	25	1 8
100	3 4	20	1 6
90	3 2	15	1 3½
80	2 11¾	10	1 0½
70	2 9½	5	0 9

With these depths, there is no *necessity* for an increase as we approach the springing lines of the arch. The depth of the arch-stones does not depend altogether upon their resistance to the compressive action of the arch and its load, as writers assert. If this were true, they might be made much smaller than practice requires. They must have, in fact, such a depth as will secure to them a leverage sufficient to counteract the displacement attendant on striking the centers, filling in the haunches, &c., and the depth necessary for this purpose is so great, as also to warrant us, in practice, to overlook the modifying effect of the proportion existing between the rise and the span of the arch.

AMERICAN PATENTS.

List of American Patents which issued from Oct. 10th, to Nov. 7th, 1854, (inclusive,) with Exemplifications.

OCTOBER 10.

32. For an *Improvement in Railroad Car Seats;* Charles P. Bailey, Zanesville, Ohio.

Claim.—"I claim the so hinging together of the back, seat, and feet rests of a car seat, as that the back may be reversed, and the seat and feet rests swing both ways of a vertical line drawn through their centre, for the purpose of forming a self-adjusting seat, applicable alike to the car, whichever end may go foremost."

33. For an *Improvement in Machinery for Making Hat Bodies;* Leander W. Boynton, South Coventry, Connecticut.

"My improvement consists in the method of revolving and vibrating two hollow perforated cones, in connexion with an exhausting, picking, and blowing apparatus, and in so varying and governing the direction of the blast, that by putting the fur (in its ordinary state,) on to the feeding aprons, and setting the machine in motion, (by any convenient power) there will be formed two complete hat bodies ready for hardening, with the quantity of stock duly proportioned to the several parts."

Claim.—"I claim the method of using the cones by giving them a rotary and a vibratory motion, in such a manner as to bring every part of the outer surface of each cone into such a position that each part may receive its due proportion of stock to form a hat body, when constructed and made to operate as described. Also, the method of varying the direction of the apertures by the vibratory motion of the cones."

34. For a *Shingle Machine;* John A. Bradshaw, Lowell, Massachusetts.

Claim.—"I claim shaving shingles by causing them to pass between the faces of two

revolving rims, having volute threads cut thereon, and armed with suitable cutters or plane irons, and one of the said cutter rims being so hung as to be self-adapting to the varying thickness of the shingles."

35. For an *Improvement in Spinning Rope and Cordage;* J. Carpenter, City of N. Y.

Claim.—"I claim the elevation of the spool above the flyer shafts, so as to occupy the space between the flyer and the ball, whereby the heads of the flyer can be shortened, and a greater velocity obtained for the revolution of the flyer, thus increasing the speed of spinning by Whipple's process, and the regulation of the revolution of the spool by means of the friction wheel, whereby the yarn, whose draft and twist are governed by the capstan, is wound up as fast as it is delivered, with less tension, and with less liability to break."

36. For a *Rotary Pump;* Stephen D. Carpenter, Madison, Wisconsin.

Claim.—"I claim, 1st, A machine for pumping and forcing air, water, or other fluid, without the use of the ordinary valves used in pumps. 2d, Also, the peculiar arrangement of the air chamber, so as to avoid the trouble and expense of affixing a separate appendage for that purpose. 3d, Also, the peculiar arrangement of the air chamber, the application of the fan-shaped bar or 'propeller,' and the manner of constructing the outside shell, by which combination, when operated as described, to dispense with the use of the ordinary valves in pumps, lessen the expense, and enhance the durability and efficacy of the pump, and in these respects to render it more available for the use and purposes than any other pump in use."

37. For an *Improved Machine for Turning Hubs, Tool Handles, &c.;* S. Carpenter, Flushing, New York.

Claim.—"I claim, 1st, The use or employment of the pulley, constructed to communicate a continuous rotary motion to the stuff to be turned, and to allow the same to be fed freely through its axis at the proper intervals. 2d, The arrangement and combination of the pulleys, screw and worm wheels, levers and slide, for the purpose of operating the cutters and bit or auger. 3d, The arrangement of the belt shipper attached to the lever, and the arm attached to the upright, for the purpose of causing the turned articles to be cut off from the stuff of equal length."

38. For *Cutter Heads for Planing Machines, &c.;* John D. Dale, Philadelphia, Pa.

Claim.—"I claim the combination and arrangement of the screw hubs, inclosed in the concentric spaces formed in the heads, and capable of being turned by the hand or otherwise, racks or cogged bars acting as supports and guides to the heads."

39. For an *Improved Rock Drill;* Edwin G. Dunham, Portland, Connecticut.

Claim.—"I claim, 1st, so arranging a horizontal plate on the drill rod, that by bringing the lifter in contact with it, in the manner described, it will be caused to incline slightly during the raising of the drill bar, and consequently to bite or impinge upon said bar, and hold it firmly until it is raised to the position desired, and then, as the lifter escapes, again assume nearly a horizontal position, quit its hold, and fall with the drill. 2d, Rendering the friction plate for raising and dropping the drill bar, capable of removing said bar entirely out of the holes which are drilled, by employing, in connexion with it, the friction plate, which is set inclined, and made to hold the bar as it is gradually raised. 3d, The plate, when set inclining sufficiently to hold the drill while it is being raised out of the holes that are drilled, whether it be used in connexion with the friction plate or other arrangements in use for raising the drill bar. 4th, I claim increasing the friction of the plate upon the drill bar, and accelerating the descent and blow of the drill bar, by means of a spring arranged as described."

40. For an *Improvement in Magnetic Alarm Bells;* Augustus Eckert, Trenton, Ohio.

Claim.—"I claim combining with the train of mechanism that strikes the alarm, an endless screw, driving the toothed wheel, and one or more revolving levers, the said endless screw being fixed upon a sliding shaft that carries a brake wheel or disk, so that when the motion of the toothed wheel is arrested by the short arm or detent catching the levers, the sliding shaft will advance, carrying before it the spring until the motion of the train is stopped by the disk coming in contact with the brake pieces, and so that on the release of the levers, the force of the spring shall throw the levers off the detent, and release the disk from the brake pieces."

41. For *Improved Sewing Pin;* Thaddeus Fowler, Waterbury, Connecticut.

Claim.—"I claim the emery ball with the pin point fixed in its metallic rim, and provided with the hinged pin and hook, by which it is attached to the dress of the user, or to a table cloth."

42. For an *Improvement in the Construction of Sugar Making Apparatus;* Louis A. Gossin, Thibodeaux, Louisiana.

Claim.—"I claim, 1st, The arrangement of the boilers for generating steam, the pans for evaporating the juice, and the furnace, whereby a single furnace is made to supply the heat for both the generation of steam and the boiling of sugar, through the contact of the naked flame with the bottom of the pans. 2d, The combination of the skimmer, consisting of a series of scoops, inclined aprons, and conduits, with the evaporating pan. 3d, The combination with the discharge tube of the sugar syrup pan, of a jacket communicating at either side with and forming a part of the feed pipe of the steam boiler, whereby a stream of water is kept constantly flowing through the jacket to protect the syrup adhering to the sides of the pipe from being discolored by burning."

43. For an *Improvement in Railroad Chair Machinery;* Benjamin F. Gossin, Covington, Kentucky.

Claim.—"I claim, 1st, The combination of the semi-circular wheels, pillow blocks, rods, lever, and rod, for giving motion to the crank shafts, and throwing in and out of gear. 2d, The combination of the two crank shafts, the cutters attached to the said cranks, frame, and cutters attached to the said frame, all for the purpose of cutting the lips from the blank plate, and turning the same around the mandrel, and thereby forming the complete chair. 3d, The tapering of the two sets of cutters, 10 and 11, so as the cutters 10 will fall freely from the chair after being completed. 4th, The adjustable sliding piece to which the cutters, 11, are attached by means of bolts, or their mechanical equivalents, the piece is held to its place by the key, and is made so as to adjust the cutters to suit different thicknesses of iron, or to compensate for the wear of the cutters. 5th, The table on which the blank chair is laid between the two sets of cutters, the upper surface of said table extending up flush with the upper surface of the shaft cutters, and in this case attached to the framing of the machine at its upper part by means of bolts, or to any other part of the machine that may be desired, and substantially effect the purpose required."

44. For an *Improvement in Construction of Ships;* John W. Griffith, City of N. Y.

Claim.—"I claim the method of increasing the strength of ships by vertical plates of iron extending up vertically from the keelson to one or more decks, and secured to the keelson and deck, and extending the whole length of the ship. And I also claim giving additional strength to ships by means of longitudinal bulk heads of plate iron, and interposed between the centre keelson and the sides of the ship, and extending from the side timbers to the deck, and secured to them, whether made water tight or of open lattice work."

45. For an *Improvement in Brakes for Checking and Starting Cars;* Robert Grant City of New York.

Claim.—"I claim the application and employment of a spring, spiral or other similar convenient form, of metal or other suitable material, in combination with the axle or wheel, or other running gear of railroad cars or other vehicles, for the purpose of stopping and starting, or either, a car or vehicle. Also, the apparatus for winding up or compressing said spring, and causing it to act upon the axle or wheel by means of the fast and revolving clutches, with their connexions and escapements. Also, the employment and application of sectional tubes or washers on the axle or shaft, when used in the said combination, for the purpose of preventing the spring from binding, and to enable the same to be easily and fully compressed."

46. For an *Improvement in Compounds for Neutralizing Chlorine;* Eben N. Horsford, Cambridge, Massachusetts; patented in England, May 9, 1854.

Claim.—"I claim the process of neutralizing chlorine by means of the substance called anti-chloride of lime."

47. For an *Improvement in Pawl Drills;* Simon Ingersoll, City of New York.

Claim.—"I claim the centre piece constructed with two gudgeons or pivots, or their

equivalents, for the wheels to turn upon, and to form or support the fulcra of the lever by which the drill is operated, thereby enabling the operator to vibrate the lever in the same plane with the shaft and drill, or in a plane at right angles to it, as may be most convenient."

48. For an *Improved Saw Gummer;* John Jack, Fayetteville, Ohio.

Claim.—"I claim the arrangement of the parts of the machine, in combination with a short die lever, bearing a friction roller, and another hand lever to manœuvre an eccentric working on said friction roller, as a means of working a hand machine for gumming saws, whereby said machine is rendered more compact, portable, economical, and efficient than any at present known or used."

49. For an *Improvement in Cans for Holding Liquids;* L. Jennings, Erving, Mass.

Claim.—"I claim the wooden can having its upper head convex, and being furnished with a handle, as described."

50. For an *Improvement in Looms;* Stephen C. Mendenhall, Richmond, Indiana.

Claim.—"I claim opening the shed by a pattern wheel so arranged that while its rotary motion commences the opening of the shed, it shall have a vertically yielding motion to and with the treadles, when combined with a wedge-shaped bar on the lay, arranged to separate the treadles, and thus complete the opening of the shed, both the pattern wheel and wedge-shaped bar being moved by the lay."

51. For a *Shingle Machine;* Elijah Morgan, Morgantown, Virginia.

Claim.—"I claim the providing of the head block with an oblong straight slot, a zigzag slot, and a fulcrum, and combining the same with an arrangement of mechanism similar to that herein specified, or its equivalent. I also claim the arrangement for holding the log."

52. For an *Improvement in Fastenings for Garments;* Richard Oliver, City of N. Y.

Claim.—"I claim, in buttons or fastenings for clothes, having one end of their eyes hinged or rigidly fastened to the button, making the eye elastic, in combination with the cavity or counter-sink, to facilitate the inserting of the other end of the eye into the hole, or its equivalent, into which it is hooked in closing the eye to fasten the button."

53. For an *Improvement in Machines for Splitting Horn, &c.;* Emerson Prescott, Leominster, Massachusetts.

Claim.—"I claim a single platen press of power sufficient, when the shell or horn is softened or rendered expansive by heat, to reduce it to a uniform thickness on the carriage, and to preserve it in such state preparatory to and while it may be moved against the splitting knife."

54. For an *Improved Damper for Ovens;* John P. Sherwood, Fort Edward, N. Y.

Claim.—"I claim the arrangement of the revolving damper, whereby the heat of the oven can be tempered and regulated."

55. For an *Improvement in Ginning and Cleaning Cotton;* C. Speer, City of N. Y.

Claim.—"I claim the combination of an endless belt or chain with the roller beater, the said roller beater being placed so as to work directly upon the flat or closed portion of such belt or chain, while its closed teeth holds the fibre, thus performing the whole separating process without the intervention of any other machinery, other than that of feeding and clearing the machine."

56. For an *Improvement in Steam Engines;* Henry Tongue, Nashville, Tenn.

Claim.—"I claim constructing the piston of a semi-rotary engine with sliding metallic packings, in combination with the stop and cylinder."

57. For a *Polishing Machine;* Henry Volkening, City of New York.

Claim.—"I claim the application of an elastic substance, as cushion, between the polishing material and the body to which the same is attached."

58. For an *Improvement in Turning Lathes;* Albin Warth, City of New York.

Claim.—"I claim the guide levers, or their equivalents, in combination with the spring slides, or their equivalents, and the guide plates or their equivalents."

59. For an *Improved Locomotive Lamp;* Irvin A. Williams, Utica, New York.

Claim.—"I claim, 1st, Constructing the can with partitions for preventing the swash of the fluid, and insuring a steady feed to the burner. 2d, The combination of the perforated inverted cone, cap, funnel, and perforated tube, for admitting air to the can, and preventing the slopping of oil from the vent."

60. For an *Improvement in Smut Machines;* Thos. B. Woodward, Philadelphia, Pa.

Claim.—"I claim covering the apertures by which the air is discharged from the fan case into the side pipes with grates, to temper and diffuse the blast, prevent the grain from getting into the fan case and being broken by the fans and retarding the machine by the friction it produces."

61. For an *Improvement in the Construction of Sugar Boilers;* Edward J. Woolsey, Astorio, New York.

Claim.—"I claim an apparatus consisting of a centrifugal distributor, arranged within a heated pan, or otherwise arranged relatively to heated surfaces, which are equivalent to the heated interior surface of the pan, or of the coils contained therein, so as to throw the juice, syrup, or solution to be evaporated, in a shower, or minutely subdivided state, on the said heated surfaces, and allow it to trickle down the sides of the pan or the said heated surfaces in a thinly diffused state, for the purpose of evaporating its moisture."

62. For an *Improvement in Processes for the Manufacture of Salt;* Samuel B. Howd, Assignor to Thomas F. Davis, James F. Leach, and R. F. Stevens, Syracuse, N.Y.

Claim.—"I claim, 1st, Mixing weak with strong brine in the steam chamber of the boiler, and passing the brine thus mixed into a settling apartment or chamber connected with the lower part of the boiler, and thereby causing the separation and deposite of impurities from the brine before it comes into contact with the fire surface of the boiler. 2d, The method of purifying brine, viz: by evaporating it in closed boilers to such an extent as to cause the separation and deposit of its impurities while under pressure of steam, in combination with vats for crystallizing the salt from the brine thus purified."

OCTOBER 17.

63. For an *Improvement in Looms for Weaving Cut Pile Fabrics;* Erastus B. Bigelow, Boston, Massachusetts.

Claim.—"I claim, 1st, The method of adapting the cutting knife to the proper position relative to the wire to be cut out under the varying conditions of the loom, by making the frame or carriage which supports or carries the said cutting knife movable. Also, in connexion with said movable frame or carriage which supports or carries the cutting knife, a guide or guides to rest against the wire to be cut out, to preserve said frame or carriage and cutting knife in a proper position relative to said wire. Also, connecting the cutting knife with the reciprocating bar, by means of a double acting or compound joint. Also, in combination with the reciprocating bar, or its equivalent, with which the cutting knife is connected, the employment of a guide which shall move in unison with said cutting knife to insure its proper position relative to the wire to be cut out. And, finally, I claim the method of preventing the wires from being drawn down on their sides, by means of hooks or bars."

64. For an *Improvement in Power Looms;* Joseph T. Barnes, Manayunk, Penna.

Claim.—"I claim, 1st, Fitting the journal boxes of the crank shaft to slide on ways on the framing, upon which, when liberated by reason of some obstruction in front of the reed, they are capable of being drawn back to carry back the crank shaft from its operative position, and prevent the further advance of the lay, by springs, or their equivalents. 2d, Setting free the journal boxes of the crank shaft from the hooks, or their equivalents, which hold them in proper operative position, by means of a rock shaft or roller hung in bearings, in rear of the breast beam, or otherwise conveniently placed near the front of the loom, said shaft or roller having attached to it a bar, which is conveniently placed for the breast beam to pass under it, and for the shuttle, when the latter is arrested in front of the reed, to be driven against it and drive it forward, and thereby throw up two arms which are also attached to the shaft or roller, and cause the latter arms to set free the journal boxes of the crank shaft, and allow them to retreat and carry

back the shaft. 3d, Furnishing the crank shaft with cams, which, when the loom is started with the shaft thrown back, work in contact with fixed pins or projections on the loom framing, and throw the shaft and its journal boxes forward to their operative position."

65. For an *Improvement in Machinery for Trimming Hat Bodies;* Daniel Barnum, City of New York.

Claim.—"I claim, in combination with the pick or brush, and perforated cone or former, the employment of currents of air at the bottom and sides to guide and direct the deposit of fur on to the cone or former. Also, the employment of a form made of grass cloth, or other flexible material pervious to air, on which to deposit the fibres in forming the bat, and to be taken from the perforated metallic cone or former with the bat, and retained inside as an 'inlayer,' during the after process of hardening. And, finally, I claim the employment of an india rubber cap, to be put on to the bat of fur to hold the fibres together in taking off the bat from the perforated cone or former, and to facilitate the hardening of the bat in the dry state."

66. For *Water Metres;* Joseph D. Elliot, Leicester, Massachusetts.

Claim.—"I claim the combination of the measuring chambers or reservoirs with the cock, that is to say, so that a measured quantity of water shall be let in and drawn off at each and every turning of the cock. Also, in combination with the cock and reservoirs, the register made as described. Also, in combination with the reservoirs, the air passage with its float, or equivalent valves, for the purpose of forming a governor to receive and discharge the water under the same head."

67. For a *Smoke Consuming Stove;* E. A. Hill, Joilet, Illinois.

Claim.—"I claim, 1st, The combination and arrangement of the smoke passage, damper, and draft flues, for the purpose of conducting the unconsumed smoke or carbonic oxide through completely ignited coals, in a simpler and readier manner than has been done before. 2d, The combination of the draft flues with the pipe, for the purpose of supplying the stove with the necessary quantity of air to insure the complete combustion of the fuel, or for preventing the smoke smothering the fire."

68. For an *Improvement in Shoemakers' Edge Planes;* D. W. Horton, Petersburgh, Indiana.

Claim.—"I claim the combination of the guard with the head and the blade, in such a manner as to form a sole and heel edge plane that is adapted to the use of the right or left hand."

69. For *Iron Buildings;* Bernard J. La Mothe, City of New York.

Claim.—"I claim, 1st, The construction of the frame or skeleton of buildings with bands or plates of iron or steel, or other metal, riveted or secured together in sets of several parallel bands, the same extending from the foundation to the top of the structure in lieu of columns, pillars, or walls. 2d, The making of the beams for the floors, and the rafters for the roof, by bending a certain number of the parallel bands which have been used in the perpendicular walls below, to the required position to serve as beams and rafters, the same being strongly riveted or screwed together. 3d, The vertical continuous beam, constructed of several parallel plates strongly riveted together, and also the combination of the horizontal and vertical beam of parallel plates."

70. For an *Improvement in Grain and Grass Harvesters;* John H. Manny, Freeport, Illinois; ante-dated June 15th, 1854.

Claim.—"I claim the arrangement of the platform obliquely to the cutter, so that the gavels of cut grain will be discharged at a sufficient distance from the standing grain to leave a clear pathway between the two for the team to travel in. Also, the combination with the platform of a wing, to facilitate the gathering of the grain. Also, making the outside dividing finger hollow, so that while it affords sufficient room for the play of the end of the sickle, the bearing of the latter thereon will not be so wide as to afford a lodgment of gum, grass, &c., and render it liable to be clogged thereby."

71. For an *Improved Grinding Surface in Mills;* Charles Ross, Rochester, New York.

Claim.—"I claim the forming of a grinding surface in mills, by lining a cast iron concave with radial segments, of burr or other stone, said segments being fitted and secured to their places."

72. For an *Improvement in Roving Tubes;* Moses Sargent, Jr., Meredith, N. Hamp.

Claim.—"I claim combining with the common trumpet-mouthed roving tube, one or more hooks, so as at all times to secure the condensing of the roving while unbroken, and permit a broken roving to be pierced without stopping the machine, or even a single tube."

73. For a *Sawing Machine;* John J. Squire, St. Louis, Missouri.

Claim.—"I claim, 1st, The employment or use of the radius guide, arranged and applied to the saw for the purpose of controlling the same, and preventing any tremor thereof. 2d, Placing the feed rollers in a movable or sliding frame, for the purpose of gauging the stuff to be sawed, and properly presenting said stuff to the saw, and guiding it while being sawed."

74. For an *Improvement in Water Pipes;* Richard B. Stevenson, York, Ohio.

Claim.—"I claim the combination of pipe of sheet zinc, or other suitably cheap and durable sheet metal, and an exterior coating of said hydraulic cement mortar of requisite thickness for strength, durability, and impermeability, for conveying water or other fluids beyond the action of frost, from one point to another."

75. For an *Improvement in Processes for Enameling Iron;* Conrad F. Thornin and Charles Stumer, Cincinnati, Ohio.

Claim.—"We claim treating the cleansed surface of the sheet or wrought metal to be enameled with a mucilage or viscid solution, and powdering or otherwise evenly distributing the pulverized frit thereon."

76. For an *Improved Joint for Toilet Glass;* Henry Wayne, Cincinnati, Ohio.

Claim.—"I claim the vibrating bracket, having a segmental wing with tapered indentations and spring pawl, or their equivalents, in combination with the horizontally rotating pivot, as described, forming a shifting joint for a toilet glass."

77. For an *Improvement in Brick Presses;* E. D. Williams, Wilmington, Delaware, and T. Tyrrell, York, Pennsylvania.

Claim.—"We claim, 1st, The employment, placed between the mechanism which produces the first, and that which produces the final pressure, of a perforating apparatus, consisting of a number of pins which are protruded through the bottom of a box, or its equivalent, and which is otherwise arranged, to perforate or prick the partly pressed clay to allow of the escape of air which may be contained therein before the final pressure. 2d, The particular method of giving the said movement by means of the loose collar fitting to the shaft, and having prominences and depressions corresponding to similar depressions and prominences on a fixed collar, and having projections on its side to come in contact with spring dogs attached to the framing."

78. For an *Iron Bridge;* John Yandell and Joseph H. Johnson, St. Louis, Missouri.

Claim.—"We claim the peculiar mode of connecting together of all the several parts as they are employed in the tension tress work, and also as the mode of combining the same with suspension cables."

79. For an *Improvement in Vessels for Holding Liquids;* James H. Stimpson, Ex'r. of James Stimpson, dec'd., late of Baltimore, Maryland.

Claim.—"I claim the double wall pitcher, the same consisting in a pitcher with double sides, double bottom, and a hinged cover, from which the liquid contents are to be poured through or over a nose or lip. Also, the employment of a chain or string attached to the handle and lid of the pitcher."

80. For an *Improved Pen and Pencil Case;* John Richardson, City of New York.

Claim.—"I claim the operating sleeve, having a turning as well as a sliding movement, in combination with the pen and pencil holders, and the interior mechanism."

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81. For an *Improvement in Ploughs;* Henry F. Baker, Centreville, Indiana.

Claim.—"I claim providing the share, which forms part of the mould board, with a curved slotted arm, and attaching the slotted curved end to the arm, and its forward end to the point, and combining the same with the curved slotted arm and adjusting lever,

through the vibrating rod, in such a manner that the ploughman can, while behind the plough, adjust the mould board in the arc of a circle, with greater convenience and facility than heretofore."

82. For an *Improvement in Sifting and Bolting;* M. S. Bassett, Wilmington, Del.

Claim.—"I claim the riddle, as described, in connexion with a shaft and bearings, centralizing said riddle so as to rotate against an ordinary flat sieve disk at its margin, as a feeder, distributor, and vibrator."

83. For an *Improvement in Smut Machines;* John D. Bedwell, Uhricksville, Ohio.

Claim.—"I claim the rotating inner and stationary outer cylinders, both constructed of overlapping metal bars, when combined and arranged with an outer close cylinder, and operating in connexion with a fan blast or suction made to communicate with the interior of the rotating bar cylinder, as well as with the inclosed space surrounding the outer stationary bar cylinder, and with the trunk."

84. For an *Improvement in Straw and Grain Separators;* Archibald Bowen, Wadesville, Virginia.

Claim.—"I claim the method of separating grain and chaff from the straw, by the combination of the inclined vibrating bed with the perforated jointed bed, so that the grain and chaff are separated from the straw, and the straw conveyed over the foot of the machine by the bed, B, while the bed, E, conveys the grain and chaff in the opposite direction, and submits the same to the action of the fan blast for further separation. Also, the extending of the upper screen by the double inclined plane, in combination with a blast compressed by a covering above the screen, for the purpose that an eddy may be formed by the blast, and the grain, if carried too far by the blast, be returned upon the inclined plane to the screen."

85. For an *Improvement in Machinery for Softening Hemp and Flax;* Robt. Boyack, Poughkeepsie, New York.

Claim.—"I claim softening flax, hemp, &c., by means of a reciprocating plate having a slot through it, and working between two pairs of fluted rollers, the flax or hemp passing between the two pairs of rollers, and through the slot in the plate, and operated upon by the plate and rollers."

86. For an *Improvement in Machinery for Cleaning Cotton;* Samuel W. Brown, Lowell, Massachusetts.

Claim.—"I claim making racks or grids to be used in cotton and other pickers, of a number of bars of iron, or other substance, each of these bars being beveled to an edge, and these edges so arranged and placed in the rack that the cotton or other substance will first come in contact with the edges of the bars as it is thrown forward over them by the beater. The bars of these racks being tied or held together once in about three inches, more or less, by cross-ties, they being cast with the bars of the racks, or otherwise firmly connected to the bars for the purpose of staying them, and always presenting parallel slots of equal width for the dirt to pass through."

87. For an *Improvement in Chairs for Round Rails;* P. S. Devlan, Reading, Penna.

Claim.—"I claim the method of confining cylindrical rails at their joints by a chair which forms the rail between the joints, and so made as to keep and support the rails in proper line, whilst they may at the same time be turned in their bearings in said chairs, as well as the intermediate ones."

88. For an *Improvement in Mill Bushes;* George L. Dulany, Long Meadow, Va.

Claim.—"I claim the use of springs actuating the nuts on draw bolts."

89. For an *Improvement in Seed Planters;* Absalom B. Earle, Franklin, N. York.

Claim.—"I claim constructing the drag bar and drill tube, and connecting them. 2d, The spring guard plate fitted in each delivery opening between the hopper and the slide, to prevent the fracture or bruising of the seed, when the slide is drawn suddenly back."

90. For an *Improvement in Granaries;* Ebenezer Ford, Spring Cottage, Mississippi.

Claim.—"I claim the mode of making granaries, having the walls, floors, and partitions filled in with common salt."

91. For an *Improvement in Gutta Percha Stereotype Compositions;* Julius Herrick, City of New York.

Claim.—"I claim making moulds and plates for printing characters or figures of gutta percha or india rubber, compounded with some other substance or substances, which shall give to the compound the required hardness and stiffness, and not destroy its plasticity when in a heated state."

92. For an *Improvement in Bran Dusters;* Joseph Johnston, Wilmington, Delaware; ante-dated April 24th, 1854.

Claim.—"I claim constructing the frames of the concaves or cylinders which support the wire cloth in bran dusters of cast metal, so as to secure the objects and advantages specified."

93. For an *Improvement in Looms;* Barton H. Jenks, Philadelphia, Pennsylvania.

Claim.—"I claim, 1st, The single spiral cam, in combination with the shifting clutch and lever for raising and lowering, alternately, a two shelf shuttle box, or holding the same stationary for a longer or shorter period. 2d, The method of rendering the pattern or pin wheel capable of working larger patterns than it could heretofore work without increasing its size, by means of a multiplier, whether the same be constructed, arranged, and connected with the wheel, or otherwise, provided the wheel has its capacity increased. 3d, One shuttle binder, whether placed in the front or back of the lay, in combination with a series of shuttle boxes, in such manner that the binder will perform the ordinary duties of that instrument for every shuttle box of a series however numerous. 4th, Arranging and operating the shuttle binder independent of the shuttle boxes, in such manner that it shall be withdrawn from the shelves at the proper time to allow the boxes to be moved without obstruction from it. 5th, The method for clearing the shuttle from the picker, preparatory to raising or lowering the shuttle boxes, by moving the shuttle from the outer end of the box a short distance by a slight forward movement of the picker, or holding the picker slightly in advance of its extreme back position, until the shuttle is in place, and then allowing it to retreat back from the end of the shuttle, whereby the picking mechanism detaches itself from the shuttle before the shuttle box moves, instead of making this clearance dependent upon the motion of the lay, or other parts of the loom, as heretofore. Lastly, The construction of the shifting cam for working the treadles with its two screw tread and nuts of unequal pitch formed on separate sections of the cam, the sections which contain the thread of longest pitch being removable, so that a corresponding piece with a thread of different pitch may be substituted to adapt the cam to operating a variable number of treadles, and likewise to facilitate repairs."

94. For an *Improvement in Manufacturing Carpets and Rugs;* John G. McNair, West Farms, New York.

Claim.—"I claim a new fabric which I denominate tapestry chenille, consisting of tapestry chenille weft woven with the colors to produce the designs in sections, but without the ground color of the intended design, which prepared chenille weft is afterwards woven into and combined with a Brussels, ingrain, or other web, which is to constitute the ground of the design."

95. For an *Improvement in Fire Arms;* Gustav Friederick Palmié and Anton Herrmann Palmié, Berlin, Prussia.

Claim.—"We claim, 1st, The formation of a cushioned valve seat upon the end of the needle bar, to close the opening through which the needle passes into the charge, and also to prevent concussions of the main spring. 2d, The safety locking bolt, being an independent positive stop to hold the main spring and prevent the discharge of the gun when desired."

96. For an *Improved Pen Holder;* Myer Phineos, City of New York.

Claim.—"I claim the use or employment of a spring reacting in both a longitudinal and transverse direction, in combination with a cylindrical pen holder."

97. For an *Improvement in Machinery for Polishing Paper;* Edward L. Perkins, Roxbury, Massachusetts.

Claim.—"I claim the combination of the pressing roll, a bed plate (over which the roll runs back and forth,) to support the paper beneath the roll and feeding rolls, or the

equivalent thereof, arranged to feed the paper across the bed plate with an intermittent motion, which alternates with the passage of the pressing roll along the bed plate."

98. For an *Improvement in Making Wrought Iron Direct from the Ore;* James Renton, Cleveland, Ohio.

Claim.—"I claim combining with the combined deoxidizing apparatus and puddling furnace, the employment of a blast or blasts to be forced on the deoxidized ore on the hearth or hearths, to aid in decarbonizing the ore and increasing the heat."

99. For an *Improved Sliding Pen and Pencil Case;* John H. Rauch, City of N. York.

Claim.—"I claim the employment of the cylindrical turning slide, having a T-shaped slot cut in its upper end, and a spur secured in one of its lips, in combination with the slotted pen and pencil tube, and pins of the pen and pencil, when said tube is provided with three longitudinal slots and a transverse groove, or their equivalents."

100. For an *Improvement in Pen and Pencil Cases;* John Richardson, City of N. Y.

Claim.—"I claim the combination of the adjusting pin with the pen and pencil holders, and the sliding ferrule for moving them in and out. Also, the parallel slots in the frame, in combination with the adjusting pin, whereby the holder may be increased and diminished in length by extending and contracting its upper end."

101. For an *Improvement in the Square, Scale, Level, and Bevel;* Josiah Shanklin, Parkersburgh, Virginia.

Claim.—"I claim the combination of the blades with the grooves and thumb screws, in such manner that my instrument can be used for the purpose of a square, bevel, level, and scale."

102. For an *Improvement in Safes;* Benjamin Sherwood, City of New York.

Claim.—"I claim the combination of clay with about an equal quantity of alum of commerce, or any other salt that will dry heat, to form a fire-resisting and fire-annihilating compound. I also claim placing in the safe next the outer walls, a thin fire-brick or tile, to protect the composition from the contact of fire, when the iron shall have burnt through."

103. For an *Improvement for Fastening Lamps to Lanterns;* E. Sirret, Buffalo, N.Y.

Claim.—"I claim fastening the lamp to the bottom of a lantern, by means of a vibrating spring lever carrying a bolt pivoted near each end of it, said bolts passing through the bottom of the oil cup to enter a groove or flanch inside the bottom of the lantern."

104. For an *Improvement in Stoves;* Oron W. Wade, Versailles, New York.

Claim.—"I claim a stove, the sides of which are doubled, and made, one of them, of transparent or translucent material, and the other of an opaque substance, one or both of which may be removed or replaced at pleasure."

105. For an *Improvement in Mills;* William Warwick, Birmingham, Penna.

Claim.—"I claim the mode of regulating the cut of grinding mills by the insertion of a traveling wheel or anti-friction roller, in combination with the beveled track on which the roller travels. Also, the position of the thumb screw, it being parallel with the handle, and not as in other mills, perpendicular with the cutting burr and shell. Also, its use as a journal for the traveling roller."

106. For an *Improvement in Rotary Steam Engines;* B. H. Wright, Rome, N. York.

Claim.—"I claim, 1st, Whenever a central piston wheel is used, the double cylinder, the one sliding on the other. 2d, The two parts separately, and in combination, viz: the method of inserting a single piece of packing in the inner surface of the piston through an aperture or recess in the latter, with a corresponding but limited cut in the piston wheel, together with the mode of protecting this aperture by the lateral overlap of the base or flanches of the piston. 3d, The double oscillating valve, having opposite wings, nevertheless preserving the advantage of a single wing through the peculiar outline or use of a lesser cylindric surface between the wings on the side of the piston channel, reducing the cut in the cylinder for the passage of the piston to the least practical dimensions. 4th, The introduction, in connexion with a like cylindric surface, between the two wings on the opposite side of the valve, of a partition and separate chamber adjacent to the outer wing, for the purposes explained. 5th, The arrangement, in connexion with the oscillating valve of the induction and eduction passages, such that the

first open just at the termination of the revolution of the valve athwart the piston channel, and the second by an aperture in the valve cap, uncovered by the opposite wing when the valve is in the position before stated, the purpose of the arrangement being to promote regularity of movement, and the working of steam expansively. Also, the method of compensating for the less ready action of steam directly on the piston by the use of tappets, which are forced by the revolution of the valve down the abrupt inclination of an exterior cam wheel. 6th, Separately, the passage through the valve, commencing near its periphery and terminating at the plane surface or valve seat, as described, and as a combination for bringing the valve down across the piston channel. I claim the combined action, first, of the entering steam on its adjacent end of the valve; second, of the steam passing through the valve entering its induction wing from the piston channel, and discharging from the eduction wing against the valve seat; and, third, taking away, to any desirable extent, the resistance in the separate chamber behind the eduction wing. 7th, The method of balancing the pressure on the cylindrical cut-off valve, that is to say, by the removal of a suitable extent of surface diametrically opposite to the passages, or where there are two passages proximately situated, it is obvious a middle point may be used. These cuts or openings not being designed for steam passages, it is evident that their size or dimensions will be governed by totally distinct considerations. 8th, Governing the velocity of the engine by changing the position of the eccentric disk, which governs the motion of the cut-off valves, by the lever from the governor, said disks when thus changing having a transverse motion on the shaft. 9th, The annular steam chamber formed in one of the heads opposite to the piston channel, with branches to the cut-off cylinders respectively; and a like chamber in the other head as a common receiving chamber for the eduction ports."

107. For an *Improved Air Heating Furnace;* Walter Bryant, Assignor to John B. Kelsey, Boston, Massachusetts.

Claim.—"I claim the improvement in the construction of the radiator, arranged over the dome of the fire pot, the same consisting in making its bottom a concavo-convex plate or arch, and with the concave side disposed downwards and directly over the said dome, whereby the ascending heat from the top of the dome is retained in the concavity of said bottom, and not only made to warm to greater advantage the air that rushes into the same, but to heat the radiator so as to improve the draft through the fire pot and supporting columns of the radiator."

108. For an *Improvement in Bearings for Loose Pulleys;* William Campbell, Assignor to self and E. W. Shippen, Philadelphia, Pennsylvania.

Claim.—"I claim a loose or suspension pulley, or pulleys and hanger, having an axis, whereby a loose pulley may revolve independently of the shaft."

109. For an *Improvement in Securing Lamps and Lanterns;* Wm. Porter, Williamsburgh, N. York, Assignor to Joseph N. Howe, Boston, Massachusetts.

"My invention consists in placing the springs which hold the two together entirely beneath the base of the lamp, and in combination therewith, in surrounding the lamp with a flanch or cup, which shall effectually prevent any oil which may escape from the lamp from dropping upon either dress or furniture."

Claim.—"I claim as my invention, the lantern, as above described."

110. For an *Improvement in Roller Catch in Self-Acting Mules;* Mark R. Pearson, Georgetown, Assignor to self and Samuel Shaw, Wareham, Massachusetts.

Claim.—"I claim combining with the catch and the ratchet, the arm and its friction brake, or the equivalent therefor."

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111. For an *Improvement in Steam Engines;* Nathan Atherton, Philadelphia, Pa.

Claim.—"I claim a cylinder with inclined projections for operating the valve gear by motion taken directly from the cylinder, whereby the proper lead may be given to the steam, whether the cylinder be turning to the right or left, and the engine is rendered more convenient, compact, and durable, than any heretofore known in which the axis of the driving shaft is parallel to that of the piston."

112. For an *Improved Key for Tuning Piano Fortes;* A. Bassford, City of N. York.

Claim.—"I claim combining the socket spindle with the handle spindle, by the inter-

position of cog gearing, or the equivalent thereof, to increase the leverage of the handle spindle relatively to the socket spindle, and have the axis of the two in or nearly in the same line. And, also, in combination with the two spindles combined together with interposed gearing, the employment of an arm or lever rest projecting from the plate of the interposed gearing to form a rest."

113. For an *Improved Press for Printing in Colors;* A. M. and G. H. Babcock, Westerly, Rhode Island.

Claim.—"We claim, 1st, The arrangement and combination of the polygonal platen and beds. Also, the construction and arrangement of the inking rollers, consisting of the vibrating arms and springs for holding out the rollers in place. Also, the combination of arms, or their equivalents, for giving a series of impressions forming progressive levers. Also, the apparatus for turning the prism, consisting of the vibrating arm, disk, springs, and pins, or their mechanical equivalents, with the apparatus for engaging and disengaging the same. Also, the arrangement and combination of the friskets with the platens, and the springs attached thereto, for giving a firm hold while drawing the sheet from the type."

114. For a *Knife Die for Cutting Leather Straps for Whips;* C. Baeder, City of N. Y.

Claim.—"I claim the use of the spiral knife die to cut gradually tapering strips of leather, for the manufacture of raw hide and braided whips."

115. For an *Improvement in Grain Winnowers;* Joseph Barker, Honesdale, Penna.

Claim.—"I claim the combination of the conical hopper, circular screens, with inclined sides, or of conical form and fan."

116. For an *Improved Burglar's Alarm;* Ephraim Brown, Lowell, Massachusetts.

Claim.—"I claim the making of the knob of the drawer movable, and so combining it with an alarm apparatus as to cause an alarm to be sounded whenever an attempt to open the drawer by pulling on the knob is attempted. Also, the combination of the latch or spring bolt, and the secondary bolt and key or lever, with the movable knob and the drawer. Also, the combining of the alarm pawl with the knob rod by means of a movable hanging lever, to be operated or moved by a stud, or its equivalent, fixed to the knob rod. Also, the decoy key and its connexions with the hanging lever, so as to operate as specified. Also, the connecting the said hanging lever to the secondary lever, so that a forward pull on the secondary lever shall move the hanging lever, so as to effect the sounding of the alarm. Also, the combination of the counter or numbered wheel, and its operative mechanism, with the knob rod, the same being to exhibit the number of attempts at opening the drawer, meaning also to claim the so combining the operative mechanism of the counter wheel with the hanging lever, that a movement of the latter will effect a movement of the said wheel."

117. For an *Improvement in Apparatus for Tempering and Flattening Saws;* Wm. Clemson, Boston, Massachusetts.

Claim.—"I claim making those ends of the plate which the saw enters, with their faces of beveled or other receding form, whereby they are enabled to impart heat to the saws by radiation before they enter, and thus cause every part of the saw to be heated to a proper degree before being submitted to the pressure of the upper plate."

118. For a *Shingle Machine;* Harry H. Evarts, Assignor to self and A. J. Brown, Chicago, Illinois.

Claim.—"I claim placing the blocks to be sawed into shingles in a rotating carriage, which is combined with inclined tables, or a single table, and with saws, or a single saw, in such a manner that the blocks will be carried continuously forward, and be automatically operated upon, to convert them into shingles. Also, the arrangement of the weighted levers, the fastening teeth, and the inclined planes with each other, and with the inclined tables and the outer series of teeth in the ledger. Also, presenting the sides of the fibres of the wood to the action of the saws in the sawing of shingles, or equivalent articles, for the purpose of giving them smoother surfaces than can be produced by the usual mode of sawing."

119. For an *Improved Burglar's Alarm;* Junius Foster, Green Point, New York.

Claim.—"I claim the spring barrel with the zig-zag groove around its circumference, in combination with the lever, bell, and stop, or its equivalent."

120. For *Machines for Filling Match Frames;* Wm. Gates, Jr., Frankfort, N. York.

Claim.—"I claim the feeding bar, with its projections, pressure rods, and gauge block, with the springs or their equivalents, combined, for the purpose of feeding the slats or strips properly to the match frame, and adjusting them therein, and also causing the ends of the match sticks to be on a level, to insure an equal immersion in the necessary compound with which they are covered."

121. For an *Improvement in Tooth Clothing for Picker Cylinders;* Robert Heneage, Lowell, Massachusetts.

Claim.—"I claim the improved manufacture of a metallic clothing of a pick cylinder, the same being made of a thin plate of metal, with the teeth cut or stamped out of it, and bent from and directly above, and so as to stand at angles with the spaces from which they are cut. Also, so arranging the base plates of the teeth on the periphery of a cylinder, or the surface to which they are to be fastened, that one of said base plates shall overlap the other, and extend over and cover the spaces, or out of which the teeth of the latter plate may have been formed, the same serving not only to give support to the teeth, but to prevent such spaces from becoming clogged with fibrous material, or other matter, when the cylinder is in use, and also to increase the pitch of the front ends of the teeth beyond what they would have were the entire lower surface of each strip made to rest upon the surface of the cylinder."

122. For an *Improvement in Fire Arms;* John C. Howe, Milwaukie, Wisconsin.

Claim.—"I claim the arrangement of the breech operating lever by its hinges or joints, with the breech hung, and movable guide or slide at the back of the breech."

123. For an *Improvement in Machinery for Making Rope and Cordage;* John Harris, Lansingburgh, John B. Scott and Galen Richmond, Troy, New York.

Claim.—"We claim, 1st, The arrangement of the gears upon shaft, in combination with the clutch upon shaft, so that by changing the position of the clutch, we increase, retard, or arrest the motion of the friction rim, and reverse these motions instantly. 2d, The spider, arranged in combination with the cam and the spiral spring upon the shaft, to give it a revolving motion to rub the strands."

124. For *Improved Seats for Wagons;* Chesley Jarnagin, Clinton, Tennessee.

Claim.—"I claim making and attaching to the running gear of wagons, a safe, comfortable, and convenient seat for wagon drivers."

125. For an *Improvement in Machinery for Picking Cotton and other Fibrous Substances;* Richard Kitson, Lowell, Massachusetts.

Claim.—"I claim, 1st, Providing the cylinder or other foundation to which the picking teeth are secured, with orifices or perforations distributed in all directions among the teeth, for the purpose of blowing a number of streams of air among the teeth from the underside of and through the fibre, and thereby expelling outwardly, during the picking operation, all dust and dirt, and loosening the fibres, and finally blowing them from the teeth. 2d, The method of securing the teeth in the cylinder, by means of notched strips and shoulders on the teeth."

126. For an *Improvement in Tailors' Measuring Instruments;* John M. Krider, Newtown, Stephensburgh, Virginia.

Claim.—"I claim the use of the protractor at the point indicated, for the purpose of determining the cardinal point at the top of the back seam."

127. For *Attachment to Siphon;* Samuel Lenher, Philadelphia, Pennsylvania.

Claim.—"I claim so constructing a siphon that its long leg near the lower end thereof shall be surrounded with an elastic substance, as tow, cotton, india rubber, &c., forming a piston upon the exterior of said hollow leg, in combination with a cylinder, in which said piston may slide, for the purpose of creating a flow of liquid through the siphon by a quick withdrawal of the cylinder, without its coming in contact with the piston."

128. For an *Improved Tailors' Measure;* Warren Lillibridge and Charles F. Lillibridge, Zanesville, Ohio.

Claim.—"We claim the construction of flexible measures, so as to retain and show the form as well as the dimensions of the surface measured."

129. For an *Improvement in Railroad Car Axles;* James E. M'Conncll, Wolverton, England.

Claim.—"I claim the constructing of hollow axles of bars of wrought iron running lengthwise, the edges lapping into each other by joints, which are welded and worked into form."

130. For an *Improvement in Cartridges for Breech Loading Fire Arms;* Dan. Moore, Williamsburgh, New York.

Claim.—"I claim the cone of paper or other suitable substance attached to and entering the rear end of the breech loading cartridge, to concentrate and pass the flash from a detonating cap."

131. For an *Improved Powder Flask for Breech Loading Guns;* D. Moore, Williamsburgh, New York.

Claim.—"I claim the method of loading fire arms from the breech by means of the pipe, so constructed and attached to the powder flask that the same forms a ramrod to force the ball into the barrel the required distance, and at the same time measure the powder for filling the chamber behind the ball."

132. For an *Improved Arrangement of Mechanism for Sawing off Piles under Water;* Vincent Palen, Portsmouth, Virginia.

Claim.—"I claim the combination of the devices for guiding and holding the saw up to the kerf, so as to prevent it from cramping and buckling in its kerf, the same consisting in the arrangement of the guides and saw shaft on the adjustable frame."

133. For an *Improved Pen and Pencil Case;* John Richardson, City of New York.

Claim.—"I claim the construction and arrangement of a pen and pencil case, so that by the acts of extending and contracting the case, either the pen or pencil can be protruded and drawn in."

134. For an *Improvement in the Manufacture of Bricks;* L. E. Ransom, Havana, O.

Claim.—"I claim the manufacture of bricks by first spreading the tempered mortar or clay at once upon the ground where the bricks will be left to dry, and in beds of certain desired length, width, and thickness, and then, while the mortar is in a soft state, or before it shall crack by too much drying, producing therein lines of weakening or separation, defining the dimensions of the bricks, without regard to their smoothness or final finish, and after the bricks, in drying, shall have separated from each other along the lines thus formed, turning them on edges, and squaring and polishing their edges, and defining the thickness of the same by rubbing over them the metallic tool, or otherwise; the desired thickness of the bed being produced by means of guide bars or moulds, and scraper or lute, whereby I am enabled to dispense with off-bearers, and otherwise to simplify the manufacture of bricks."

135. For a *Machine for Manufacturing Mast Hoops;* E. W. Scott, Lowell, Mass.

Claim.—"I claim the feed rolls, L and K, the feed rolls, I and J, and the cutters and cutter heads, when they are so constructed, arranged, and operated as to round or finish and shape the mast hoops while passing the said cutters and rolls, which shape, round, or finish them, parallel to the grain, the hoops being at liberty to take their natural course, excepting where they are held by the feed and friction rolls, and where the cutter heads and cutters are operating to dress them."

136. For an *Improved Soldering Furnace;* Wm. J. Stevenson, City of New York.

Claim.—"I claim providing a soldering furnace with an air tube and a recess, or their equivalents, so that the entire circumference of each of the joints of the can shall be soldered all at once, and during the performance of the same, no other parts of the can, besides the lap and that portion of the bottom or top upon which the ring of solder lies, exposed to a melting heat."

137. For an *Improvement in Odometers;* Samuel R. Thorp, Batavia, New York.

Claim.—"I claim the combination of the spring with the band and the ratchet wheel."

138. For an *Improvement in Odometers;* Julius Thompson, Middleborough, Mass.

Claim.—"I claim communicating motion from the wheel of the vehicle to the working parts of the odometer, by means of a cylindrical weight or wheel placed within the

case of the implement, and detached therefrom, so that said weight or wheel will, by its own gravity, remain at the lower part of the case, and in one position, and by the arrangement herein shown, viz: the fork and eccentric, or other suitable device, communicate the necessary motion to the working parts of the implement as the case rotates."

139. For an *Improvement in Grate Bars;* Samuel Vansyckel, Little York, N. J.

Claim.—"I claim the casting or forming of the pin, dowel, or catch, in one bar or set with a corresponding hole, or its equivalent, in the next bar or set, so that when put together they shall be held from warping, twisting, or dropping from the end plates or walls."

140. For an *Improved Arrangement in Spark Arresters for Heating Feed Water;* R. A. Wilder, Schuylkill Haven, Pennsylvania.

Claim.—"I claim the arrangement of the water space, the flue spaces, and the perforated cone, all concentric with each other."

141. For a *Water Metre;* S. R. Wilmot, New Haven, Connecticut.

Claim.—"I claim, 1st, Extending the sides of the piston upwards in the form of a tube, to enter an open bottomed but close topped chamber, in which a quantity of air, or its equivalent, is so confined as to press equally on the water above and below the piston, and thus prevent it overflowing the top of the tube on either side, and hence to form an effectual air seal or packing, and allow the piston to be fitted to the cylinder so loosely as to produce no friction. 2d, Enclosing all the mechanism by which the valves are actuated within the cylinder itself, or in a chamber in free communication with the same, whereby the necessity for stuffing boxes or other packing for the valves, rods, or other parts connected with the valves, and the consequent expense of construction, and friction of such packing is obviated."

142. For an *Improvement in Machinery for Cutting Rags for Making Paper;* Alonzo S. Woodward, Lowell, and Benjamin F. Bartlett, Pepperell, Massachusetts.

Claim.—"We claim, 1st, The cylindrics, made, constructed and used for the purpose of cutting paper rags and other paper stock. 2d, Our before-described cylindrics, in combination with the cuttting knife. 3d, The combination of the two sets of feed rolls with the cylindrics and knife, one set of them, the feed rolls, running at a greater speed than the other set, for the purpose of evenning the stock before it reaches the cylindrics and cutting knife."

143. For an *Improvement in Surface Condensers;* Wm. Sewell, Brooklyn, N. York; patented in England, January 13th, 1854.

Claim.—"I claim, 1st, The elastic supplementary tube sheet. 2d, The method of preventing the endwise sliding or creeping of the tubes. 3d, So constructing the guard that it performs, in addition to its own duty, the further office of holding down the edges of the elastic tube sheet, preventing the entrance of water behind the same. And, lastly, the injection or showering apertures, in combination with a surface condenser, wherein the steam space is outside of the tubes, and which is also provided with proper entrances and dischargers for circulating water through the tubes, whereby a surface condenser may be converted, at will, into a jet condenser."

Additional Improvements.

1. For an *Improvement in Machinery for Polishing Raw Hide Whips;* Chas. Baeder, City of New York; dated Oct. 17, 1854; original patent dated May 21, 1850.

Claim.—"I claim the combination of the endless belt with the bearer, for smoothing and polishing raw hide whips, said bearer furnishing the facility for examining the progress of the operation."

2. For an *Improvement in Whiffle Tree Hooks;* Martin Newman, 2d, and N. C. Whitcomb, Lanesborough, Pennsylvania, and G. C. Cole, Hartford, Connecticut; dated October 31st, 1854; original patent dated February 21st, 1854.

Claim.—"We claim the construction of a trace fastened on the ends of a whiffle-tree, consisting of a rolling latch turning on a pin spring, in combination with a hook and catch or detent thereon."

3. For an *Improved Safety Washer for Securing Wheels to Axles;* Wm. Thornley, Philadelphia, Penna.; dated Oct. 31, 1854; original patent dated Sept. 19, 1854.

Claim.—"I claim a washer with a projecting flanch and two stops, as described."

RE-ISSUES.

1. For an *Improvement in Sewing Machines;* Isaac M. Singer, City of New York; dated October 3d, 1854; original patent dated August 12th, 1851.

Claim.—"I claim giving to the shuttle an additional forward movement after it has been stopped to close the loop, for the purpose of drawing the stitch tight, when such an additional movement is given at and in combination with the feed motion of the cloth in the reverse direction, and the final upward motion of the needle, so that the two threads shall be drawn tight at the same time. Also, controlling the thread by what I have termed the friction pad between the seam and the bobbin, or any equivalent therefor, and for any or all of the purposes specified. Also, placing the bobbin from which the needle is supplied with thread, on an adjustable arm attached to the frame, when this is combined with the carrying of the said thread through an eye or guide attached to and moving with the needle carrier, or the equivalent therefor, whereby any desired length of thread can be given for the formation of the loop, without varying the range of motion of the needle. And, also, in a sewing machine, feeding the cloth or other substance to determine the space between the stitches by the friction of the surface of the periphery of the feed wheel, or any equivalent feeding surface, in combination with a spring pressure plate or pad, which gripes the cloth or other substance against such feeding surface."

2. For an *Improvement in Fire Arms;* Horace Smith and Daniel B. Wesson, Norwich, Connecticut; dated Oct. 11, 1854; original patent dated Feb. 14, 1854.

Claim.—"We claim the combining the percussion hammer, the piston slide, and the barrel, so that the said piston slide shall not only serve as a breech to the barrels, but at the same time as a means of conveying (by concussion,) to the priming of the cartridge at one end of the slide, the force of the blow of the hammer upon the opposite end of the slide. Also, the improvement in the carrier, whereby it is not only enabled to be moved downwards, while the breech slide is forward against the barrel or cartridge therein, but is caused to expel from the chamber in which it moves, the remainder of the cartridge, after such remainder has been retracted by the piston slide, and while the carrier is being elevated with another cartridge; the said improvement consisting in making the carrier with an opening or passage leading out of the cartridge chamber thereof, and of a width sufficient for the movement of the piston slide out of the carrier during the descent of the latter, and providing said carrier with one or more projections, or the equivalent thereof, which, when the carrier is elevated, shall be moved against the remainder of the cartridge, and elevate and expel it from the fire arm so stated, the breech slide or piston slide being formed as specified. Also, the arrangement and application of the percussion hammer with respect to the breech slide and the trigger guard lever, so that the hammer may be moved and set to full cock by the pressure or back action of the slide induced by the action of the trigger guard lever. And, also, the improvement of making the front end of the piston slide with a dove-tail recess, or its equivalent, for the purpose of enabling the slide to seize the metal or remainder of the cartridge, and withdraw it from the barrel, when it (the piston slide,) is next retracted, the said remainder being discharged from the slide by the upward movement of the carrier."

3. For an *Improvement in Caloriferes;* Samuel Whitmarsh, Northampton, Mass.; dated October 10, 1854; original patent dated August 17, 1852.

Claim.—"I claim the combination of the water supply reservoir, the chamber or bed of sand, and a furnace or chamber of combustion."

4. For an *Improvement in Smut Machines;* John Hollingsworth, Zanesville, Ohio; dated October 10, 1854; original patent dated April 22, 1851.

Claim.—"I claim the manner of scouring and freeing wheat of smut and other impurities, by throwing the mass out of the concave at each revolution of the beaters, and against the inclined or curved face of a chimney fitted to an opening at or near the top of the concave, for the purpose of permitting the dust, smut, &c., to pass out, whilst the wheat is returned back into the machine for a second operation. Also, in combination with the concave, the adjustable inclined aprons, for conveying the grain through the concave as it is successively returned back into the machine."

5. For *Improvements in Rakes to Grain Harvesters;* Jearum Atkins, Chicago, Illinois; dated October 31, 1854; original patent dated December 21, 1852.

Claim.—"I claim the means of transmitting motion from the driving wheel to the

raking apparatus. Also, secondly, the collecting, grasping, and depositing of the cut product, by means of a rake and palm."

DESIGNS FOR OCTOBER, 1854.

1. For *Franklin Stoves;* William Reser, Cincinnati, Ohio; dated Oct. 3, 1854.
Claim.—"The ornamental design and configuration."

2. For *Clock Case Fronts;* Charles Chinnock, City of N. York; dated Oct. 17, 1854.
Claim.—"The design and configuration, termed the 'Three Bells' pattern."

3. For *Clock Case Fronts;* Charles Chinnock, City of N. York; dated Oct. 17, 1854.
Claim.—"The design and configuration, termed the 'Harlem Gothic' pattern."

4. For *Clock Case Fronts;* Charles Chinnock, City of N. York; dated Oct. 17, 1854.
Claim.—"The design and configuration of the base, pilaster, buttresses, cornice, crown piece, and ornaments."

5 For a *Franklin Stove;* William Reser, Cincinnati, Ohio; dated October 17, 1854.
Claim.—"The ornamental design and configuration of the stove plate."

6. For a *Cooking Stove;* Wm. P. Gray, Assignor to Cox, Hager & Cox, Philadelphia, Pennsylvania; dated October 17, 1854.
Claim.—"The design, configuration and arrangement of the several ornaments in bas relief, and mouldings on the front, sides, and feet of the stove 'Atlantic.'"

7. For *Franklin Fire Places;* Nathaniel S. Prince, Boston, Mass., Assignor to Franklin, Muzzy & Co., Bangor, and A. Lambard, Augusta, Me.; dated Oct. 31, 1854.
Claim.—"The ornamental design of the front of the fire place, the folding blower, the top plate, and the side."

8. For *Brackets;* Isaac De Gouche, Troy, New York; dated Oct. 31, 1854.
Claim.—"The ornamental configuration and design."

NOVEMBER 7.

1. For an *Improvement in Sewing Machines;* Daniel C. Ambler, City of New York.
Claim.—"I claim, 1st, The method of sewing a felling down, or zig-zag seam, by means of vibrations in a line perpendicular to the seam, or nearly so, imparted either to the needle or to the cloth. 2d, The combination with the needle having such motions, or the equivalent thereof, of a shuttle thrown in the direction perpendicular, or nearly so, to the general direction of the seam. 3d, An automatic lever for clamping the thread upon the up stroke of the needle. 4th, Imparting to the needle a partially reciprocating rotating motion upon its own axis. And, lastly, connecting two vibrating needles, each to each, whereby one vibrating mechanism serves for both needles, and said needles may also be adjusted so as to sew seams simultaneously at any required distance apart."

2. For an *Improvement in Locks;* John B. Brennan, Mount Vernon, New York.
Claim.—"I claim placing the sliding tumblers between two arms, one of which is attached to the bolt, and the other arm to the bolt tumbler, the tumblers having recesses cut in them at each end."

3. For an *Improvement in Machinery for Polishing Stone;* Albert Broughton, Malone, New York; ante-dated October 24th, 1854.
Claim.—"I claim causing the stones polished to be rotated around their own axes, or the axes of their receiving frames, by the polishing friction produced by the rotating polishing surface upon said stones."

4. For an *Improved Trap for Animals;* Robert S. Craig, Cincinnati, Ohio.
Claim.—"I claim the mechanical combination of the machinery."

5. For an *Improved Joint in Water Wheels;* Reuben Daniels, Woodstock, Vermont.
Claim.—"I claim the peculiar construction of the joint between the rims of the shute

and wheel, that is to say, the upper edge of the rim of the wheel being rabbeted on the inside, and the under edge of the rim of the shute being rabbeted on the outside, so as to match together."

6. For an *Improvement in Stone Drilling Machines;* F. Davison, Petersburgh, Va.

Claim.—"I claim the peculiar device for clamping and releasing the drill bars, consisting of the dog, to which the chain, or its equivalent, is attached, and the trigger for locking and unlocking the same on the drill bar, said dog and trigger being constructed, combined, and arranged within the catch block, so that the latter locks the former at the termination of the descent of the catch blocks, and unlocks it at the termination of the ascent thereof, by striking some part of the framings of the machine, or certain fixtures provided for the purpose."

7. For an *Improvement in Glass Furnaces;* Jacob Green, Philadelphia, Pennsylvania.

Claim.—"I claim the introduction of a blast of hot air among the combustible gases, after they have left the fire chamber, and during their passage through an intermediate flue, so that the combustible gases and hot air may enter the furnace together well mixed, and through the presence of a sufficient supply of oxygen effect an entire or nearly entire combustion of carbon and other combustible matter in the furnace, and consequently a great saving of fuel and better color and quality of glass."

8. For an *Improvement in Corn Shellers;* Samuel Gumaer, Aurora, Illinois.

Claim.—"I claim, 1st, The carrying up of the ears of corn from the hopper against the brake, by means of the rotation of the cylinder, where the larger portions of the ears are first reduced, preparatory to their being finally divested of the grains."

9. For an *Improvement in the Manufacture of Buckles;* Sheldon S. Hartshorne, Orange, Connecticut.

Claim.—"I claim the manufacture of a buckle of three parts, by dies or swedges, in such manner that the two ends of the wire of the main frame shall be secured by the socket of the tongue part, while the other part will have a free independent motion, when the whole is constructed and fitted for use."

10. For an *Improvement in Glass Furnaces;* A. K. Hay, Winslow, New Jersey.

Claim.—"I claim a trench around a central fire pot, and between it and the seiges."

11. For *Barrel Machinery;* Horace S. Higgens, Graham, Indiana.

Claim.—"I claim the combination of the shaft with the sectional expanding cutter rim."

12. For an *Improvement in Bottle Stoppers;* T. Kendall, San Francisco, California.

Claim.—"I claim the constructing of bottles, jugs, or jars, with a tri-threaded screw in the neck of each, for the purpose of holding safely the cork or stopper thereof, and the convenience of inserting or withdrawing the same, the threads of the said screw having the peculiar form and beveled surface indicated by the form of the core on which said bottle necks are to be formed."

13. For an *Improvement in Furnaces for Heating Buildings;* Joseph Leeds, Philadelphia, Pennsylvania.

Claim.—"I claim, in combination with the chamber above the fire box, the deflector and frustrum, with the exit pipe passing through it, for the purpose of regulating the draft and throwing it from the centre towards the sides of the burning mass, and thus produce equable combustion."

14. For an *Improvement in Vulcanizing Elastic Gums;* E. E. Marcy, City of N. Y.

Claim.—"I claim the combination of selenium with india rubber, as a curing or vulcanizing agent."

15. For an *Improvement in Coal Hods;* Wm. N. Martin, Bristol, Rhode Island.

Claim.—"I claim separating the main central chamber of a coal hod or bucket from the outer sides and bottom of the same, by an interior lining of sheet metal partially perforated, or of sheet metal and wire grating, combined in such a manner as to form a dust chamber between said lining and the exterior of the hod or bucket, open at the rear and closed in front, by which the coal only will be discharged at the front side of the bucket, and the dust be deposited in the said dust chamber, and when the coal is all discharged

from the bucket, the dust can be removed from its receptacle therein, by movements the reverse of those required in discharging the coal from its receptacle."

16. For an *Improvement in Potato Diggers;* Ives W. McGaffey, Philadelphia, Penna.

Claim.—"I claim arranging two endless chains of elevators on drums, (which have their axes standing at right angles, or nearly so, to the screen and digger,) and having the elevators of one of said chains come opposite the spaces between the elevator of the other chain."

17. For an *Improved Mode for Sawing Bolts for Staves;* B. McKeage, Accatink, Va.

Claim.—"I claim the improved form of the segments from which blocks for staves are to be cut, to wit: the sides of said segments being tangential to a circle around and concentric with the heart of the log from which said segments are formed."

18. For an *Improvement in Bombs, Shells, or Grenades;* E. T. Miller, Boston, Mass.

Claim.—"I claim the combination of the barrels and chambers."

19. For an *Improvement in Manufacturing Leather Banding for Machinery;* George Miller, Providence, Rhode Island.

Claim.—"I claim my improved manufacture of round banding, that is to say, by reducing a strip of leather, or other suitable material, to the shape denoted, and subsequently rolling and cementing it together."

20. For a *Slate Frame;* Edmund Morris, Burlington, New Jersey."

"My invention consists in forming the frame out of a solid piece by sawing out the centre and then cutting a kerf along and through each end of the frame, through which the kerf may be inserted and adjusted in a groove previously cut to receive it."

Claim.—"I claim the mode of constructing a slate frame as described."

21. For an *Improvement in Railroad Car Brakes;* M. P. Norton, Tinmouth, Vt.

Claim.—"I claim the arrrangement of machinery by which the action of the rubber or rubbers is confined to that part of the car wheel which, as the car is moving, is forward and moving downward, and when the direction of the car is reversed, brings another rubber or set of rubbers to act upon the other side of the wheel, which is then in like manner forward and moving downward."

22. For an *Improved Farm Gate;* Dewey Phillips, Shaftsbury, Vermont.

Claim.—"I claim, 1st, The adjustable lever of any desirable length and dimensions, or its equivalent. 2d, The adjustable lever, combined and arranged with the gate and posts, which will produce the desired effect."

23. For an *Improvement in Desulphurizing Gutta Percha and like Gums;* Wm. E. Rider and John Murphy, City of New York.

Claim.—"We claim extracting the superfluous portion of the sulphur from gutta percha, india rubber, and vulcanizable gums or gum goods, during the heating portion of the vulcanizing process, by the use of hydrogen gas in the apartment in which said heating process is performed, by which the after accumulation of sulphur upon the surface of said gums is prevented, and, consequently, the necessity of boiling them in caustic alkali entirely avoided."

24. For a *Machine for Cutting Tenons on Blind Slats;* E. W. Roff, Newark, N. J.

Claim.—"I claim the employment or use of the gauge, applied to an adjustable frame."

25. For an *Improvement in Steam Engine Valves;* C. Rumley, Rochester, N. York.

Claim.—"I claim the combination of the compound valve seat, consisting of an adjustable and a self-adjusting segment, with a rotating wing valve revolving isochronally with the piston."

26. For an *Improvement in Rotary Engines;* C. Rumley, Rochester, New York.

Claim.—"I claim making the internal curvature of such a cylinder for such a purpose, to coincide with those portions of the lines of two or three intersecting circles, of equal radius, and described from centres occupying the relative positions described, which are exterior to the points of intersection, whereby the construction of an elliptical cylinder

is greatly simplified, so that it may be bored with precision with an ordinary boring engine."

27. For an *Improvement in Machinery for Making Hat Bodies;* Isaac Searles, Newark, New Jersey.

Claim.—"I claim, 1st, The brush feeding roll, in combination with the metallic bar. 2d, The use of two or more pickers, when used to throw the fur on all sides of one and the same cone or wire gauge, for the purpose of laying the fibres of fur in all directions without depending on the rotary motion of the cone to equalize the thickness."

28. For an *Improvement in Harness Saddles;* Robert M. Selleck, City of New York.

Claim.—"I claim the depressions formed on each side of the head of the cast iron saddle tree, in combination with the gullet piece, the tongue of said gullet piece serving as a tack hold. 2d, Providing the flaps with tongues which pass under the lower parts of the frame while the flaps pass on top of the same. 3d, Making the false seat of tin, and separate from the cantel."

29. For an *Improved Form for and Mode of Operating Circular Saws;* James Slater, Macon, Georgia.

Claim.—"I claim cutting out portions of the edge of the saw at points opposite to one another, and arranging it in such relation to the crank pin that its teeth will not come in contact with the board or log, while the said crank pin is on either of the dead centres."

30. For an *Improvement in Corn Shellers;* J. P. Smith, Hummelstown, Penna.

Claim.—"I claim, 1st, The jointed shelling bars, having rests and springs, in combination with the springs and guides. 2d, I claim the vibrating feeder."

31. For an *Improved Means for Directing the Blast in Furnaces;* B. H. Washington, Hannibal, Missouri.

Claim.—"I claim the employment or use of the two hollow cones or funnels, said cones or funnels being applied as described, or in any other way, to produce the desired effect."

32. For a *Machine for Head part of Shovel Handles;* Elbridge Webber, Gardiner, Me.

Claim.—"I claim the longitudinal and lateral moving cutters, operating simultaneously on opposite sides of the handle, in combination with the cams moving the carriages, and the rotary support of the handle."

33. For an *Improvement in Locks;* Charles Wilson, Springfield, Massachusetts.

Claim.—"I claim the combination of series of opposite tumblers attached to and moving with the bolt."

34. For an *Improvement in Fire Arms;* Wendell Wright, City of New York.

Claim.—"I claim, 1st, The employment or use of the thumb trigger, F, arranged and connected with the cocking trigger, K, so that the trigger, F, may be operated by the thumb while the trigger, K, is operated by the hand. 2d, Counter-sinking the end of the stop which locks or retains the cylinder as each chamber is fired, for the purpose of enabling said stop to enter the chambers when the cartridge or powder and balls are within them. 3d, The flexible pin at the end of the hammer, whereby the pin is enabled to adjust itself to the vents of the chambers, and thus insure the ignition of the pills. 4th, The nipper boss at the side of the cylinder, when said boss is inserted within a cavity in the cheek piece, and encompassed by a fire ring, for the purpose of preventing the explosion of more than a single chamber at once, or at one operation of the trigger."

35. For an *Improvement in Loom Beams;* Samuel T. Thomas, Laurence, Mass., and Eliza Ann Everett, Adm'x. of Edward Everett, dec'd., late of Laurence, Mass.

Claim.—"What is claimed is, forming the loom beam of sectional parts or beams, which, when arranged side by side on a shaft from the entire loom beam, ready for insertion in the loom, by which arrangement the length of the loom beam may be varied, and a variety in the stripes produced by simply varying the relative positions of the sectional loom beams in the looms."

36. For an *Improvement in Carriage Lifting Jacks;* John Jenkins, Monroe, Assignor to Roe, Horton & Co., Chester, New York.

"The nature of my improvement consists in arranging the axle seat of lifting jacks in

such a manner that it will, no matter what may be the position or angle of the lifting lever, be capable always of assuming a horizontal position when the weight of the carriage comes upon it."

***Claim.*—" I claim the arrangement of the axle rest or seat."**

37. For an *Improvement in Stone Dressing Machines;* John P. Avery, Assignor to J. B. Bromley, Norwich, Connecticut.

***Claim.*—" I claim the combination and arrangement with the revolving face plate, or its equivalent, of the rotating taper or conical picks or cutters, operating throughout their length on the stone to face it, with a velocity or movement on their axes proportioned to the varied velocity given them by the revolving face plate which carries and drives them."**

MECHANICS, PHYSICS, AND CHEMISTRY.

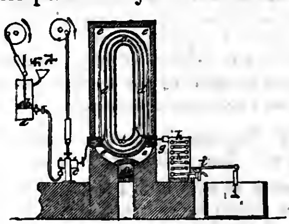
Specification of the Patent granted to Richard Albert Tilghman, *of Philadelphia, U. S. of America, Chemist, for Improvements in Treating Fatty and Oily Matters, chiefly Applicable to the Manufacture of Soap, Candles, and Glycerine.*—Dated January 9, 1854.*

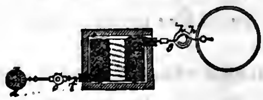
The first part of my said invention consists of a mode or modes of obtaining free fat acids and solution of glycerine from those fatty or oily bodies of animal and vegetable origin which contain glycerine as their base.

For this purpose I subject these fatty or oily bodies to the action of water at a high temperature under pressure, so as to cause the elements of those bodies to combine with water, and to obtain at the same time, free fat acids and solution of glycerine.

I mix the fatty body to be operated upon with from a third to a half of its bulk of water, and the mixture may be placed in any convenient vessel in which it can be subjected to the action of heat, to a temperature about the same as that of melting lead, until the operation is complete; and the vessel must be closed, so that the requisite amount of pressure may be applied to prevent the conversion of the water into steam.

The process may be performed more rapidly and also continuously by causing the mixture of fatty matter and water to pass through a tube or continuous channel heated to the temperature already mentioned, the requisite pressure for preventing the conversion of the water into steam being applied during the process; and this I believe is the best mode of carrying this part of my invention into effect.





In the drawing hereunto annexed are shown figures of an apparatus for performing this process speedily and continuously, but which apparatus I do not intend to claim as any part of my invention.

Fig. 1, is a vertical section of this apparatus; and

Fig. 2, shows the various parts of the apparatus in horizontal section; I place the fat or oil in a fluid state in the vessel, *a*, with from one-third to one-half its bulk of warm water; the disk or piston, *b*, perforated with numerous small holes, being kept in rapid motion up and down in

* From the Repertory of Patent Inventions, Nov. 1854.

the vessel, *a*, causes the fat or oil and water to form an emulsion, or intimate mechanical mixture. A force pump, *c*, like those in common use for hydraulic presses, then drives the mixture through a long coil of very strong iron tube, *d, d, d, d,* which being placed in a furnace, *e, e,* is heated by a fire, *f*, to about the temperature of melting lead. From the exit end, *g*, of the heating tubes, *d, d,* the mixture, which has then become converted into free fat acids and solution of glycerine, passes on through another coiled iron tube, *h, h, h,* immersed in water, by which it is cooled down from its high temperature to below 212° Fah., after which it makes its escape through the exit valve, *i*, into the receiving vessel. The iron tubes I have employed and found to be convenient for this purpose, are about one inch external diameter, and about half an inch internal diameter, being such as are in common use for Perkins's hot-water apparatus. The ends of the tubes are joined together by welding to make the requisite length; but where welding is not practicable I employ the kind of joints used for Perkins's hot-water apparatus, which are now well known. The heating tube, *d, d, d,* is coiled several times backwards and forwards, so as to arrange a considerable length of tube in a moderate space. The different coils of the tube are kept about one-quarter of an inch apart from each other, and the interval between them is filled up solid with cast iron, which also covers the outer coils or rows of tubes to the thickness of half or three-quarters of an inch, as shown in fig. 2. This casing of metal insures a considerable uniformity of temperature in the different parts of the coil, adding also to its strength and protecting it from injury by the fire.

The exit valve, *i*, is so loaded that when the heating tubes, *d, d, d,* are at the desired working temperature, and the pump, *c*, is not in action, it will not be opened by the internal pressure produced by the application of heat to the mixture, and therefore when the pump, *c*, is not in action, nothing escapes from the valve, *i*, if the temperature be not too high. But when the pump forces fresh mixture into one end, *j*, of the heating tubes, *d, d, d,* the exit valve, *i*, is forced open to allow an equal amount of the mixture which has been operated upon to escape out of the cooling tubes, *h, h,* at the valve, *i*, placed at the other end of the apparatus. No steam or air should be allowed to accumulate in the tubes, which should be kept entirely full of the mixture. For this purpose, whenever it may be required, the speed of the pump should be increased, so that the current through the tubes may be made sufficiently rapid to carry out with it any air remaining in them. Although the decomposition of the neutral fats by water takes place with great quickness at the proper heat, yet I prefer that the pump, *c*, should be worked at such a rate in proportion to the length or capacity of the heating tubes, *d, d, d,* that the mixture while flowing through them should be maintained at the desired temperature for about ten minutes before it passes into the refrigerator or cooling parts, *h, h,* of the apparatus.

The melting point of lead has been mentioned as the proper heat to be used in this operation, because it has been found to give good results; but the change of fatty matters into fat acids and glycerine takes place with some materials (such as palm oil) at the melting point of bismuth,

yet the heat has been carried considerably above the melting point of lead without any apparent injury, and the decomposing action of the water becomes more powerful as the heat is increased. By starting the apparatus at a low heat and gradually increasing it, the temperature giving products most suitable to the intended application of the fatty body employed, can easily be determined.

To indicate the temperature of the tubes, *d*, *d*, *d*, I have found the successive melting of metals and other substances of different and known degrees of fusibility to be convenient in practice. Several holes half an inch in diameter and two or three inches deep are bored into the solid parts of the casting surrounding the tubes, each hole being charged with a different substance. The series I have used consist of tin, melting at about 440°, bismuth at about 510°, lead at about 612°, and nitrate of potash at about 660°. A straight piece of iron wire passing through the side of the furnace to the bottom of each of the holes, enables the workman to feel which of the substances are melted, and to regulate the fire accordingly. It is important for the quickness and perfection of the decomposition that the oil and water during their entire passage through the heating tubes should remain in the same state of intimate mixture in which they enter them. I therefore prefer to place the series of heating tubes in a vertical position, so that any partial separation which may take place while the liquids pass up one tube, may be counteracted as they pass down the next. I believe that it will be found useful to fix at intervals in the heating tubes of such apparatus as may admit of such an addition, diaphragms pierced with numerous small holes, so that the liquids being forced through these obstructions may be thoroughly mixed together. I deem it prudent to test the strength of the apparatus by a pressure of 10,000 lbs. to the square inch before taking it into use; but I believe that the working pressure necessary for producing the heat I have mentioned, will not be found to exceed 2000 lbs. to the square inch. When it is desired to diminish the contact of the liquids with iron, the tube or channels of the apparatus may be lined with copper.

The hot mixture of fat acids and solution of glycerine which escape from the exit valve of the apparatus are separated from each other by subsidence; the fat acids may then be washed with water, and the solution of glycerine concentrated and purified by the usual means.

The fat acids thus produced may, like those obtained by other methods, be used in the manufacture of candles and soap, and applied to various purposes according to their quality; and when desired they may also be first bleached or purified by distillation or otherwise, as is now well understood.

I prefer that the fatty bodies should be previously deprived, as far as practicable, of such impurities as would cause the discoloration of the fat acids produced; but when the fat acids are to be finally purified by distillation, this preliminary purification is of less importance.

When any acid or other corrosive agent shall have been used for purifying, hardening, or otherwise preparing the fatty body to be operated upon, I take care that all traces of it shall be washed out or neutralized before passing it through the apparatus. Some fatty bodies (particularly

when impure) generate during the process, a portion of acetic or other soluble acid, which might tend to injure the iron tubes; in such cases I add a corresponding quantity of alkaline or basic matter to the water and oil before they are pumped into the tubes.

The second part of my said invention consists of a mode of treating a mixture of fatty matters (whether acid or neutral) and a carbonated alkali for the purpose of manufacturing soap.

For this purpose I mix the fatty bodies in a liquid state with the quantity of carbonated alkali in solution which may be necessary to convert it into soap, and then subject the mixture to a high temperature under pressure, in like manner as hereinbefore described in practising my mode of obtaining fatty acids and glycerine. And for this purpose the apparatus hereinbefore described for producing the fatty acids and glycerine by a continuous process may be used for the production of soap in a similar manner. The carbonated alkali may be dissolved merely in the quantity of water which is intended to remain in the soap produced. If resinous or other matters are intended to be used in the manufacture of the soap, they may be dissolved either in the alkali solution or the oil, or may be combined with the soap after it has left the apparatus.

The degree of heat required is less than that which is necessay to produce free fat acids, and should generally be kept between the melting points of tin and bismuth. At about 350° Fah. the neutral fats will form soaps, with the solution of alkaline carbonates, but a higher temperature will produce the result more quickly.

The carbonic acid expelled from the alkali in this process when performed in the apparatus above described, escapes as the soap issues from the exit valve; if but little water has been used, and the quality of the soap is sufficently good without further purification, it can be put into frames to harden at once, or it may be put into the coppers, boiled up, and separated from the glycerine (when neutral fats have been used), and finished in the usual manner.

I claim as of my invention,—

First, the manufacturing of fatty acids and glycerine from fatty bodies by means of water and heat acting thereon, as hereinbefore described; and

Secondly, the manufacturing of soap by treating a mixture of fatty matters and a carbonated alkali, as above described.

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*On Magnetic Hypotheses.**

A discourse which was recently delivered at the Royal Institution, by Professor Faraday, the purpose of which was to direct the attention of the audience to the different hypothetical attempts made to account physically for the known properties of matter in relation to its magneto-electrical phenomena, followed on very naturally to one addressed to the Institution by Dr. Frankland on the 2d instant, who then gave an account of the different views advanced by Davy, Ampère, and Berzelius, of the

* From the Lond. Mech. Mag. July, 1854.

manner in which electricity might be associated with the atoms or molecules of matter, so as to account for their electro-chemical actions, and of the logical and experimental objections which stood in the way of each. On the present occasion reference was first made to Coulomb's investigations of mutual magnetic actions, to the hypothesis advanced by him, that two magnetic fluids, associated with the matter of magnetic bodies, would account for all the phenomena; and to Poisson's profound mathematical investigation of the sufficiency of the hypothesis. Then Oersted's discovery of the relation of common magnetism to currents of electricity was recalled to mind;—hence an enormous enlargement of the scope of magnetic force and of our knowledge of its actions; and hence Ampère's beautiful investigations; and his hypothesis (also sustained by the highest mathematical investigation),—that all magnetic phenomena are due to currents of electricity; and that in such bodies as magnets, iron, nickel, &c., the atoms or particles have naturally currents of electricity running around them in one direction, about what may be considered as their equatorial parts. After Oersted's time, further experimental discoveries occurred; currents of electricity were found competent to induce collateral currents, and magnets proved able to produce like currents, thus showing the identity of action of magnets and currents in producing effects of a kind different to ordinary magnetic attractions and repulsions. Then diamagnetism was discovered, in which actions analogous to those of ordinary magnetism occurred, but with the antithesis of attraction for repulsion and repulsion for attraction; and these were so extensive, that whatever bodies were not magnetic proved to be diamagnetic; and thus *all* matter was brought under the dominion of that magnetic force, whose physical mode of action hypothesis endeavors to account for. As the hypothesis of Ampère could not account for diamagnetic action, some assumed that magnetic and electric force might, in diamagnetic matter, induce currents of electricity in the reverse direction to those in magnetic matter, or else might induce currents where before there were none; whereas in magnetic cases it was supposed they only constrained particle-currents to assume a particular direction, which before were in all directions. Weber stands eminent as a profound mathematician who has confirmed Ampère's investigations as far as they proceeded, and who has made an addition to his hypothetical views,—namely, that there is electricity amongst the particles of matter, which is not thrown into the form of a current until the magnetic induction comes upon it, but which then assumes the character of current, having a direction the contrary to that of the currents which Ampère supposed to be always circulating round magnetic matter; and so these other matters are rendered diamagnetic.

De la Rive, who has recently most carefully examined the various hypotheses, and who, as an experimentalist and discoverer, has the highest right to enter into the consideration of these deep, searching, and difficult inquiries, after recalling the various phenomena which show that the powers concerned belong to the particles of matter, and not to the masses merely (the former conferring them by association upon the latter), then distinguishes magnetic action into four kinds or modes—namely, the ordinary, the diamagnetic, the induction of currents, and the rotation of a ray; and points out that any acceptable hypothesis ought to account for

the *four* modes of action, and, it may be added, ought to agree with, if not account for, the phenomena of electro-chemical action also. De la Rive conceives that as regards these modes of action, this hypothetical result may be obtained, and both Ampère and Weber's views also retained in the following manner: All the atoms of matter are supposed to be endowed with electrical currents of a like kind, which move about them for ever, without diminution of their force or velocity, being essentially a part of their nature. The direction of these currents for each atom is through one determinate diameter, which may therefore be considered as the axis. Where they emerge from the body of the atom they divide in all directions, and running over every part of the surface, converge towards the opposite end of the axis diameter, and there re-enter the atom to run ever through the same course. The converging and diverging points are, as it were, poles of force. Where the atoms of matter are close or numerous in a given space (and chemical considerations lead to the admission of such cases), the hypothesis then admits that several atoms may conjoin into a ring, so that their central or axial currents may run one into the other, and not return, as before, over the surface of each atom; these form the molecules of magnetic matter, and represent Ampère's hypotheses of molecular currents. Where the atoms, being fewer in a given space, are farther apart, or where, being good conductors, the current runs as freely over the surface as through the axis, then they do not form like groups to the molecules of magnetic matter, but are still considered subject to a species of induction by the action of external magnets and currents; and so give rise to Weber's reverse currents. The induction of momentary currents and the rotation of a ray are considered by De la Rive as in conformity with such a supposition of the electric state of the atoms and particles of matter.

The lecturer seemed to think that the great variety of these hypotheses, and their rapid succession, was rather a proof of weakness in this department of physical knowledge than of strength, and that the large assumptions which were made in turn for each should ever be present to the mind. Even in the most perfect of them, that is, De la Rive's, these assumptions are very considerable; for it is necessary to conceive of the molecules as being flat or disk-like bodies, however numerous the atoms of each may be; also, that the atoms of one molecule do not interfere with or break up the disposition of those of another molecule; also, that electro-chemical action may consist with such a constituted molecule; also, that the motive force of each atom current is resident in the axis, and on the other hand, that the passage of the current over the surface offers *resistance;* for unless there were a difference between the axial and the surface force in one direction or the other, the atoms would have no tendency to congregate in molecules. In making these remarks, however, the speaker had no thought of depreciating hypothesis, or objecting to its right use. No discoverer could advance without it; and such exertions as those made by De la Rive, to bring into harmony thoughts which in their earlier forms were adverse to each other, were of the more value, because they were the exertions of a man who knew the value both of hypothesis and of laws, of theory and of fact, and had given proofs of the power of each by the productions of his own mind. Still the speaker ad-

vocated that mental reservation which kept hypothesis in its right place, and which was ready to abandon it when it failed; and as examples, referred to Newton, who (as is shown by his letters to Bentley,) had very strong convictions of the physical nature of the lines of gravitating force, yet in what he publicly advanced stopped short at the law of action of the force, and thence deduced his great results; and also to Arago, who, discovering the phenomena of magnetic rotation, yet not perceiving their physical cause, had that philosophic power of mind which enabled him to refrain from suggesting one.

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*On the Flow of Gas through Pipes.**†

In determining the size of main pipes capable of distributing given quantities of gas, it is necessary to combine certain empirical results derived from experiment with certain laws applicable to the movement of fluids. The modes of calculation usually resorted to for determining the dimensions of mains will be more simply discussed by dividing the subject under three separate heads: 1st, the motion of gas through simple orifices; 2d, its motion through horizontal pipes; and, 3d, its motion through pipes varying from the horizontal direction.

I. Motion through simple orifices.

The theoretical laws which apply to this case are the following:—

1. The velocity with which gas issues out of a simple orifice is as the square root of the head of water by which it is pressed. The gas in this case follows the simple law as water itself; and as the pressure applied to gas is usually estimated in inches of water, it is convenient to use this law in the form here expressed. Of course, the quantity of gas discharged through any orifice being in proportion to the velocity, all other things being alike, it follows that the quantity of gas passing through any simple orifice is as the square root of the pressure.

Let H be the height or depth of water in inches denoting the pressure on the gas, and let Q be the quantity of gas discharged through any orifice with that pressure. Let h be any other depth of water, also in inches, for which it is required to ascertain the quantity q. Then

$$\sqrt{\mathrm{H}} : \sqrt{h} : : \mathrm{Q} : q \text{ or } \frac{\sqrt{h}\,\mathrm{Q}}{\sqrt{\mathrm{H}}} = q \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

In order to illustrate this, it may be stated that the quantity discharged under 4 inches head of water will be twice as much as under 1 inch. The quantity under 9 inches will be three times as much as under 1 inch; and in the same proportion for any intermediate pressures.

The rule may be thus expressed in words. Multiply the quantity of gas delivered under the pressure of any known depth of water by the square root of the depth for which the quantity is required, and divide the product by the square root of the depth for which the quantity is known, the quotient will be the quantity delivered under the required pressure.

Suppose it has been ascertained by experiment, that under a pressure

* *Hughes' Treatise on Gas Works.* Lond. J. Weale.
† From the Lond. Artizan, Feb. 1, 1854.

of 3 inches of water 400 cubic feet of gas are discharged per hour through a certain opening, it is required to know how many cubic feet of the same gas will be discharged through the same opening with a pressure of 2 inches of water.

Here $\frac{\sqrt{2} \times 400}{\sqrt{3}} = \frac{565\cdot6}{1\cdot732} =$ 327 cubic feet, the quantity required.

2. The pressure remaining constant, the quantity of gas discharged through a simple orifice will be inversely as the square root of its specific gravity. It is evident that the lighter gas will flow out with a much higher velocity than the heavier, and the exact proportionate velocity of the two has long been proved to follow the law just quoted.

Let G be the specific gravity of a gas whose rate of delivery through any orifice in a given time is equal to Q, and let it be required to find the quantity q which will be delivered under the same circumstances when the gas has a specific gravity equal to g.

$$\text{Here } \sqrt{g} : \sqrt{G} :: Q : q \text{ or } \frac{\sqrt{G}\,Q}{\sqrt{g}} = q \quad . \quad . \quad . \quad (2)$$

Suppose it were known that cannel coal-gas of specific gravity ·550 were delivered out of an orifice at the rate of 400 feet per hour, and it is required to ascertain the rate at which a very light inferior gas of specific gravity ·380 would pass under the same pressure through the same orifice.

Here $\frac{\sqrt{\cdot550} \times 400}{\sqrt{\cdot360}} = \frac{296\cdot64}{\cdot6} =$ 494 cubic feet per hour, the quantity which would be delivered of the lighter gas.

3. The pressure and specific gravity remaining constant, the discharges of the same gas through different openings are as the areas of the openings, or as the squares of their diameters. Thus, all other circumstances being alike, an orifice of 2 inches diameter will discharge four times as much gas as one of 1 inch; an orifice of 3 inches diameter will discharge nine times as much; and so on.

This rule is not strictly correct in practice, being based on the theoretical supposition of an entire absence of friction. Since there is less proportionate friction in a large opening, the discharge in practice is more than that assigned by theory for large openings. Many gas engineers, however, have estimated the size of their mains according to this law, and have not thought it advisable to reduce the size below that given by theory, because the excess allows for errors and imperfections in laying the pipes, and for other contingencies which may obviously arise.

Let D be the diameter of any orifice through which the quantity Q can be discharged, then the quantity q which will be discharged through any other opening of the diameter d will be

$$\frac{d^2\,Q}{D^2} = q \quad . \quad . \quad . \quad . \quad . \quad (3)$$

For example, suppose 1000 feet of gas are discharged per hour through an orifice half an inch in diameter, required the quantity of the same gas which would be discharged through an orifice $4\frac{1}{4}$ inches diameter.

Here $\frac{4\cdot25^2 \times 1000}{\cdot5^2} = \frac{19062}{\cdot25} =$ 76248, the quantity discharged through

the large orifice. It is probable that several hundred feet more would be actually discharged than the quantity determined by theory, for the reason already stated.

We now come to the combination of practical results with the theoretical rules which have been laid down for determining what Mr. Clegg very properly calls the *initial* velocity of the gas—that is, the velocity with which it commences to flow through an opening, as distinguished from its velocity after passing through a main pipe of greater or less length. It is to be regretted that the practical experiments by which theory is to be compared, and in some cases modified, are here very scanty and insufficient. Mr. Clegg gives a table showing the quantities discharged through a very small circular orifice of only one-fourth of an inch diameter at different pressures, from half an inch up to 5 inches. On calculating the quantities which ought to be discharged in proportion to the discharge under the lowest pressure, the results are sufficiently near, as will be seen from the following comparison:—

Table of the quantity of carburetted hydrogen gas of specific gravity ·420 which will flow per hour through a circular orifice of one-fourth of an inch.

Pressure.	Quantity of Gas by experiment, in cubic feet.	Quantity of Gas by calculation, in cubic feet.
½ inch	80·	
1 "	113·	111·7
2 "	160·5	160·
3 "	195·	193·1
4 "	226·	226·2
5 "	253·	253·

Mr. Clegg has also another table showing the quantity of gas of specific gravity ·420 discharged by experiment and calculation, where pressure remains constant at half an inch, and the diameter of the orifice varies from one-fourth of an inch up to 6 inches.

Diameter of orifice in inches.	Quantities of Gas discharged in cubic feet per hour.	
	By experiment.	By calculation.
·25	80	
·50	321	320
·75	723	720
1·00	1287	1280
1·125	1625	1620
1·25	2010	2000
1·50	2885	2880
6·00	46150	46080

The excess in the experimental results is accounted for by the proportionate diminution of friction, as already explained.

Assuming the primary experiment, giving 80 cubic feet of gas of spe-

cific gravity ·420 discharged through one-fourth of an inch orifice, under a pressure of half an inch, to be strictly correct, and worthy of forming a basis; let it be required, by way of illustration, to determine the quantity of gas of specific gravity ·500 discharged per hour through a circular orifice of 4 inches in diameter, under a pressure of $2\frac{1}{2}$ inches of water.

First. To find the diminished quantity due to the increased specific gravity, we have

$\frac{\sqrt{\cdot 420} \times 80}{\sqrt{\cdot 500}} = \frac{51\cdot 84}{\cdot 707} = 73\cdot 3$, the quantity discharged of specific gravity ·500.

Secondly. To find the increased quantity due to the larger orifice, we have

$\frac{16 \times 73\cdot 3}{\cdot 25^2} = \frac{1172\cdot 8}{\cdot 0625} = 18765$, the quantity of gas having a specific gravity $= \cdot 500$ discharged through a circular orifice, 4 inches diameter.

Thirdly. To find the increased quantity due to the pressure of $2\frac{1}{2}$ inches, we have

$\frac{\sqrt{2\frac{1}{2}} \times 18765}{\sqrt{\cdot 5}} = \frac{29649}{\cdot 707} = 41936$, the required quantity of specific gravity ·500 which will be discharged in one hour from a 4-inch circular opening, under a pressure of $2\frac{1}{2}$ inches of water.

We now come to the second and more important practical inquiry, namely, that of determining the quantities of gas which will flow through mains of given length and area.

Mr. Clegg quotes a series of six experiments, in which gas under a pressure of half an inch head of water was made to flow through various lengths of 6-inch pipe up to thirty-four yards. From these experiments he deduces the law that the quantities of gas discharged in equal times by a horizontal pipe, under the same pressure and for different lengths, are to one another in the inverse ratio of the square roots of the length. Taking as a basis Mr. Clegg's first experiment, which gave a discharge of 44,280 feet per hour, through a pipe 3·46 yards long, we shall find the quantity discharged through a pipe 34·20 yards long by this proportion,

$$\sqrt{34\cdot 20} : \sqrt{3\cdot 46} : : 44280 : \text{required quantity};$$

or $\frac{44280 \times \sqrt{3\cdot 46}}{\sqrt{34\cdot 20}} = \frac{82361}{5\cdot 848} = 14083\cdot 6$ cubic feet, while the quantity actually discharged by experiment is 14,080 cubic feet, an experiment sufficiently accurate for all practical purposes. This mode of calculating the discharge, although founded on a very scanty basis, appears to be the only one made use of by Mr. Clegg. Putting P for the product of the discharge through a 6-inch pipe by the square root of 3·46 yards the length of the pipe, and L the length in yards of any other 6-inch pipe, the discharge per hour through L will be equal to $\frac{P}{\sqrt{L}}$, and as in this case the value of P is known, being $= 82361$, the form becomes $\frac{82361}{\sqrt{L}}$. This

formula only applies to gas of the specific gravity ·420 under a pressure of half an inch head of water.

Putting D to represent any other diameter than 6 inches, we have the quantity discharged from such a pipe

$$=\frac{8\cdot 2361\ D^2}{36\sqrt{L}}=\frac{2288\ D^2}{\sqrt{L}}$$

Putting g to represent the specific gravity of any other kind of gas, that of atmospheric air being 1, we have the quantity discharged of such a gas

$$=2288\ D^2\frac{\sqrt{\cdot 420\ H}}{\sqrt{\cdot 5\ Lg}}=2288\ D^2\sqrt{\cdot 84}\sqrt{\frac{H}{Lg}}$$

$$=2096\ D^2\sqrt{\frac{H}{Lg}}\quad \ldots\ldots \quad (4)$$

Also putting Q for the quantity of gas discharged per hour in cubic feet, we have

$$D=\sqrt{\frac{Q}{2096\sqrt{\frac{H}{Lg}}}}\quad \ldots\ldots\ldots \quad (5)$$

Mr. Clegg* has given a long series of tables, all calculated according to this formula, showing the quantities of gas of specific gravity ·420 delivered per hour from horizontal mains varying in length from 100 to 10,000 yards, and varying in diameter from 2 inches to 18 inches, under pressures varying from half an inch to 3 inches of water. There appears to be a general tendency to the belief that the actual quantities are much larger than those given in Mr. Clegg's tables, or, which is the same thing, those which would result from the formula (4). For instance, in the recent important parliamentary inquiry into the case of the Great Central Gas Consumers' Company, their engineer, Mr. Croll, estimated that with a pressure of $2\frac{1}{2}$ inches a quantity equal to 173,000 cubic feet of gas would be delivered at the end of a 26-inch main, $2\frac{1}{4}$ miles in length. Now if we calculate the quantity of gas which would be delivered from a main of this kind according to the basis of Mr. Clegg's tables, we shall find it amount to less than half this quantity.

We have seen (equation 4) that a general expression in the form $xA=Q$ may be derived from any experiment, and that it is only necessary to determine the value of the coefficient x in this equation. The part A is always of course equal to $D^2\sqrt{\frac{H}{Lg}}$, so that the coefficient x is equal to

$$\frac{Q}{D^2\sqrt{\frac{H}{Lg}}}=\frac{Q\sqrt{Lg}}{D^2\sqrt{H}}$$

We shall now determine the value of x according to this equation from several other experiments on coal gas.

* The work by Mr. Clegg which is referred to here is the one published by Mr. Weale in 1841.

Table showing the quantities of Gas discharged from a Pipe 62-100 of an inch in diameter, in the Experiments of M. Girard at the Hospital of St. Louis. In these Experiments the density of the Gas or the value of g *was* ·559, *and the Pressure or value of* H *was* 1·34 *inches.*

Length of pipe in yards.	Quantity discharged per hour in cubic feet.	Value of x Calculated from the Equation $x = \frac{Q\sqrt{Lg}}{D^2\sqrt{H}}$
41	99	1065
62	83	1096
93	74	1198
119	57	1045
138	53	1047
		5) 5451
The coefficient according to these experiments		1090

It will be observed that the value of x calculated from these experiments varies from 1045 to 1198, being a difference between the extremes equal to 14 per cent. The fairest way to adjust this variation in the experiments is, therefore, to take the mean and to assume the coefficient established by M. Girard at 1090.

(To be Continued.)

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*The Stereochrome of Fuchs.**

The formation of an insoluble cement by means of the water-glass, whenever the carbonic acid of the atmosphere acts on this substance, or whenever it is brought into contact with a lime-salt, has been applied by Fuchs to a most important purpose. The stereochrome is essentially the process of fresco secco,† invested with the capability of receiving and perpetuating works of the highest artistic character, and which may be executed on a vast scale. Fuchs's method is as follows:‡

"Clean and washed quartz-sand is mixed with the smallest quantity of lime which will enable the plasterer to place it on the wall. The surface is then taken off with an iron scraper, in order to remove the layer formed in contact with the atmosphere: the wall being still moist during this operation. The wall is then allowed to dry; after drying, it is just in the state in which it could be rubbed off by the finger. The wall has now to be *fixed, i. e.* moistened with water-glass.§ [An important point is not to

* From the London Chemical Gazette, No. 279.

† Vide Eastlake's Materials for a History of Oil Painting, p. 142.

‡ These particulars were obtained by Dr. Hofmann from Mr. Echter. A stereochromic picture by Echter, and a sample of the water-glass as prepared in Munich, were also exhibited by Dr. Hofmann.

§ The composition of the specimen was—

	per cent.
Silica,	23·21
Soda,	8·90
Potash,	2·52

[The specific gravity of the solution, 3·81.]

use too much water-glass in moistening the wall.] This operation is usually performed with a brush. The wall must be left in such a condition as to be capable of receiving colors when afterwards painted on. If, as frequently happens, the wall has been too strongly fixed, the surface has to be removed with pumice, and to be fixed again. Being fixed in this manner, the wall is suffered to dry. Before the painter begins, he moistens the part on which he purposes to work with distilled water, squirted on by a syringe. He then paints; if he wishes to repaint any part, he moistens again. As soon as the picture is finished, it is syringed over with water-glass. After the wall is dry, the syringing is continued as long as a wet sponge can remove any of the color. An efflorescence of carbonate of soda sometimes appears on the picture soon after its completion. This may either be removed by syringing with water, or may be left to the action of the atmosphere."

Not to dwell on the obvious advantages possessed by the stereochrome over the real fresco (such as its admitting of being retouched and its dispensing with joinings), it appears that damp and atmospheric influences, notoriously destructive of real fresco, do not injure pictures executed by this process.

The following crucial experiment was made on one of those pictures. It was suspended for twelve months in the open air, under the principal chimney of the New Museum, at Berlin; "during that time, it was exposed to sunshine, mist, snow, and rain," and nevertheless "retained its full brilliancy of color."

The stereochrome has been adopted on a grand scale by Kaulbach in decorating the interior of the great national edifice at Berlin, already alluded to. These decorations are now in progress, and will consist of historical pictures (the dimensions of which are 21 feet in height and 24¾ in width), single colossal figures, friezes, arabesques, chiaro scuro, &c. On the effect of the three finished pictures, it has been remarked by one whose opinion is entitled to respect, that they have all the brilliancy and vigor of oil paintings, while there is the absence of that dazzling confusion which new oil paintings are apt to present, unless they are viewed in one direction, which the spectator has to seek for.

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*On the Composition of the Sheathing of Ships.**

M. Bobierre has paid considerable attention to this subject, and has arrived at the following conclusions as to the cause of the rapid destruction of some copper and bronze sheathing:—1. When unalloyed copper is employed, the presence of arsenic appears to hasten its destruction. 2. All bronzes which appear to have stood well, contained from 4½ to 5½ per cent. of tin, that quantity being necessary to form an homogeneous alloy. When the per centage of tin is only 2·5 to 3·5, which is very frequently the case, no definite alloy is produced, and the mass is of unequal composition, and being unequally acted upon, is soon destroyed. 3. When impure copper is employed, the alloy is never homogeneous, and is unequally acted upon in consequence. We thus see, that the so

* From the London Artizan, August, 1854.

frequent destruction of the sheathing of copper-bottomed vessels arises from the tendency to use inferior brittle copper, and by diminishing the proportion of tin, to economize the difference between the price of that metal and copper, at the same time that the cost of rolling is also less, in consequence of the greater softness of the poor alloy. Bobierre thinks that the addition of a very small portion of zinc very much improves the bronze, by producing a more perfect and uniform distribution of the positive metals, and consequently a much more definite alloy.—*Comptes Rendus*, vol. xxxvii., p. 131, and vol. xxxviii., p. 122.

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*The Mints of the United States.** By PROFESSOR WILSON.†

The transmissions of gold from the new State of California, have caused a corresponding increase in the gold currency of the States, and have invested the Mint operations with more general interest than under the previous ordinary circumstances they possessed. The same condition of things exists in this country; and as it is intended to establish a mint in the gold producing colony of Australia, I thought it desirable to obtain as much information as I could in reference to the organization and working details of those in the United States.

The head establishment is at Philadelphia, and is called "The Mint;" there are also, three "Branch Mints;"—at New Orleans, in Louisiana; at Charlotte, in North Carolina; and at Dahlonega, in Georgia, respectively. The Branch Mint in California, and the Assay Office in New York, are not yet completely organized.

At the Mint in Philadelphia, gold, silver, and copper, are coined; at New Orleans, gold and silver are coined; while the branches at Charlotte and Dahlonega coin gold only. At "The Mint," the executive staff consists of a director, treasurer, chief coiner, melter and refiner, engraver, assayer, and assistant assayer. At the New Orleans Branch Mint, the staff consists of a superintendent, treasurer, melter and refiner, and coiner; and at each of the other two branch mints there are but three officers,—superintendent and treasurer (combined), assayer, and coiner. The several duties of these officers, the remuneration they shall receive for their services, and the amount of security they shall give for the due performance of them, are duly prescribed by an Act of Congress supplementary to the Act, entitled "An Act establishing a Mint and regulating the Coins in the United States;" this latter Act giving all the details referring directly to the coinage of the country.

At the United States Mint at Philadelphia, the salaries are fixed as follows:—Director, $3500; treasurer, $2000; chief coiner, $2000; melter and refiner, $2000; assayer, $2000. At the New Orleans Branch Mint the salaries are, to the superintendent, $2500, and $2000 each to the other officers; and at the other branch mints the superintendents receive $2000, and the other officers $1500 respectively. In each of the establishments, the appointment of assistants, subordinate officers and

* From the Civil Engineer and Architect's Journal, November, 1854.

† From the Special Report on the New York Industrial Exhibition.

servants, is left entirely in the hands of the chief of the different departments.

In visiting the Mint at Philadelphia I had the advantage of being taken through the several departments by the chief coiner, Mr. Franklin Peale, and the melter and refiner, Professor J. C. Booth, who kindly furnished me with the following details of their operations. As the gold is brought to the Mint in various quantities and in a crude state, it passes necessarily through the department of the refiner before it reaches that of the chief coiner; I therefore give the actual details of the refining operations upon sundry deposits of gold, amounting in the aggregate to $2,000,000.

The deposits are immediately weighed and a certificate of their gross weight issued. The fires having been lighted in the five furnaces of the deposit melting-room at four or five o'clock, A. M., all the deposits, amounting perhaps to seventy or eighty, are melted before noon; assay slips are then taken off, and the assays finished* the next morning, after which their values are calculated by the weight after melting, care being taken to include all the grains that can be procured from the flux, pots, &c., by grinding them up under a pair of small chasers, sifting, and washing. There is a clerk and his assistant and one hand wholly engaged in performing all the weighings for the treasurer, such as weighing deposits before and after melting, ingots for coinage, fine bars, and the clippings after cutting out the planchets. There are five men in the deposit melting-room, two of whom attend to two furnaces each at the same time, one to one furnace and washing grains, and the remaining two are laboring assistants. The whole deposit of $2,000,000 is melted in three or four days in the deposit-room, and assayed by from the third to the seventh day.

As soon as the first deposits are assayed, say on the third day (if expedition is necessary,) or always on the fourth, they are granulated in the proportion of one part of gold to two parts of silver. The pots contain 50 lbs. of gold and 100 lbs. of silver, equal to 1800 oz., and each melt requires about an hour. With four furnaces (attended by four melters and two aids,) there are ordinarily made thirty-two melts per day, but when hurried forty-eight melts can be made, making from one-third of a million to one-half of a million dollars per day. Two days' work, or about $650,000 worth of gold, equal in weight to one ton (avoirdupois weight,) are granulated for a single setting with acid. The granulated metal is charged into large pots, together with pure nitric acid of 39° Beaumé, between the hours of seven and nine A.M. on the sixth day, and steamed for five hours. The pots, made in Germany, are 2 feet in diameter by 2 feet in depth, set in plain wooden vats, lined with $\frac{3}{16}$-inch sheet-lead; a single coil of copper pipe passing around the bottom of the vat blows the steam directly into the water, in which the pots are set to about half their depth.

The vats are arranged in a small house in the middle of the room with a large flue connecting with the chimney-stack, so that when in action the odor of nitrous fumes is scarcely perceptible in the building. The $2,000,000 require about sixty such pots; they are stirred about once

* The mode of assaying is according to the "wet process" of Gay Lussac. This is too well known to need description here.

each hour, say altogether five times, with simple wooden paddles; the next day (seventh,) the acid solution of nitrate of silver is drawn off by a gold-syphon into wooden buckets, and transferred to the large vat, in which it is precipitated by salt (chloride of sodium,) and fresh acid added to the metals, now containing very little silver. Steaming for five hours on the seventh day completes the refining of $650,000. Early on the eighth, one pot is drawn off, washed with a little warm water, and the gold-powder transferred to a filter. Fresh granulations are put into this empty pot, and the acid of the adjoining pot baled over upon them, and thus through the series, the whole being re-charged in from two to two and a half hours. After steaming for five hours, the acid which contained but little silver from the preceding day becomes a nearly saturated solution of nitrate of silver. By this arrangement 4½ lbs. of nitric acid are consumed altogether for each pound of gold refined, and the latter is brought up to 990 a 993 m. fine,—rarely below 990. Thus every two days, 13,000 lbs. of nitric acid are used. In the course of the last year 1,000,000 lbs. of pure nitric acid, at seven cents per pound, equal to $70,000, were consumed.

The gold is washed with hot water on the filter during the eighth day, and until it is sweet, (say by 7 P.M.) The filter consists of two layers of tolerably stout coarse muslin, with thick paper between, in a tub with a false bottom, 2½ feet in diameter and 2½ feet deep, and mounted on wheels. One of the men remains, after washing hours, until 7 P.M., when the watchman of the parting-room continues washing the gold and silver until sweet, *i. e.,* until the wash-water ceases to color blue litmus paper. Early on the ninth day the wet gold is pressed with a powerful hydraulic press, and the cakes then thoroughly dried on an iron pan, at a low red heat. This process saves wastage in the melting-pot, since there is no water remaining in the pressed metal to carry off gold in its steam. The same day (ninth) the gold is usually melted with a less proportion of copper than is requisite to make standard metal, and cast into bars, which are assayed by noon on the tenth. They are then melted with the proper quantity of copper, partly on the same day, partly early on the eleventh, and assayed and delivered to the coiner the same day. On the fourteenth they are ready for delivery to the treasurer as coins.

The silver solution drawn off from the pots is precipitated in a large wooden vat of 10 feet diameter by 5 feet deep, and the chloride of silver immediately run out into large filters [$6 \times 3 \times 14$] where it is washed sweet. The filter is covered with coarse muslin, and the first turbid water thrown back; the filter, which is on wheels, is then run over to the reducing vats, and the chloride shovelled into them. There are four such vats [$7 \times 4 \times 2$] made of wood and lined with lead, 1 inch thick in the bottom. A large excess of granulated zinc is thrown on the moist chloride in the vats, without the addition of acid; the reduction is very violent, and when it slackens, oil of vitriol is added to remove the excess of zinc. The whole reduction occupies a few hours, and after a night's repose the solution of mixed sulphate and chloride of zinc is run off into the sewer.

About 2 tons of zinc per $1,000,000 of gold are employed; the silver, however, in this amount, say 10 per cent. by weight, should only take,

by equivalents, about 2400 lbs., so that nearly 2 equivalents of zinc for 1 equivalent of silver are used. This is found to be advantageous, as both time and space are greatly economized by this excess.

The day after the reduction the reduced silver is washed, and the second day it is pressed and dried by heat, the same hydraulic press as for gold being used, but with different drying-pans. The same silver is used again for making fresh granulations, but as it accumulates from the Californian gold, 10,000 or 20,000 ounces are now and then made into coin, great care being taken in this case to avoid getting gold in it when drawing off the silver solution, and in the press.

Such are the actual working details in refining a specified amount ($2,000,000) of gold, the first-third of which is delivered as coin in fourteen days after its arrival, and the third third in eighteen days.

But as there is a bullion-fund of $5,500,000 allowed by government, depositors are paid from the third to the fifth day after an arrival, *i. e.*, as soon as the gold is melted, assayed, and its value calculated. When two heavy arrivals occur in close succession, the time of refining and coining can be shortened from 14 to 10 days.

The number of men engaged in the refining department is 14: 1 foreman, 8 for the parting process, 3 for reducing, and 2 for pressing and drying. In the gold melting-room there are 3 melters and 2 assistants. The total number of hands in the melting and refining departments is 34, including a melting and parting foreman, and 3 in the place for grinding, sifting, washing, and sweeping. This last place or sweep, embraces all pots, ashes of fires, trimmings of furnaces, ashes of all woodwork, &c.

The late law for reducing the weight of silver coin necessitated an increase of force, and 15 more were in consequence employed for this purpose. While $50,000,000 in a year have been parted with the above force, they could with the same force and apparatus refine $80,000,000 if it were required.

After many experiments upon anthracite, Professor Booth stated that he had at length fully succeeded in employing it for melting both gold and silver in the same furnaces, slightly modified, in which he had been accustomed to melt with charcoal. This change had been accompanied by great economy in the cost of material and labor, and by greater comfort to the workmen, from being less exposed to heat. The cost of charcoal (of the best quality—hard pine-knot coal) is 16 cents per bushel, delivered at the Mint; and while the cost of this fuel for all their operations in 1852, when gold was chiefly refined and melted, was about $7000, the cost of anthracite will be from $600 to $1000. In using the anthracite, he found that a simple draft of air, without a blast, was quite sufficient to sustain combustion.

Californian gold frequently contains the alloy "iridosmine," which is not always detected by the assay. In order to remove it as far as possible without actually dissolving gold, it is allowed to subside, first in the granulating crucibles, and then in the crucibles for toughening (melting fine gold and copper). If the assayers report its presence in the toughened bars, they are again melted, and the iridosmine allowed to subside. By these three, and often four successive meltings, the gold

is separated from its troublesome companion as far as practicable. The gold thus refined, and reduced to the proper standard, [*Section* 8: "And be it further enacted, that the standard for both gold and silver coins of the United States shall hereafter be such, that of 1000 parts by weight, 900 shall be of pure metal and 100 of alloy; and the alloy of silver coins shall be of copper, and the alloy of gold coins shall be of copper and silver; provided that the silver does not exceed one-half of the whole alloy,"] is delivered over to the chief coiner in the form of bars or ingots of a certain weight, to be divided and shaped into pieces required for the currency of the country.

The *Coining* department of the establishment is of a power and efficiency sufficient to perform all the mechanical processes incidental to the issue of nearly 70,000,000 of pieces during the past year; and I was assured by Mr. Franklin Peale, the chief coiner, that it could have executed much more if it had been steadily employed, or fully supplied with material during the whole of that period. It is not necessary to go through the whole course of operations in this department, but to notice only such as possess novelty or present special characteristics.

The necessary power for working the machinery is obtained from a large steam-engine of the form usually known as the steeple-engine; it is a double vertical high-pressure engine, with cranks at right angles, the power being carried off by a caoutchouc belt, 2 feet wide, from a drum of 8 feet in diameter; the estimated power is equal to 90 horses. At times, this is all required, at others much less is sufficient, and in uncertain proportions; to meet this irregularity, and to ensure that steadiness of motion so necessary in such delicate operations, a governor and throttle-valve of a peculiar construction have been devised, which have now been in use for some time, and have produced most satisfactory results, fully effecting the purpose for which they were designed. The rolling mills, four in number, are driven by belts, at the rate of six revolutions per minute; the distances between the rollers being adjusted by double wedges, moved by a train of wheels which are connected with a dial-plate and bands, divided and numbered into hours and minutes, so as to indicate the proper thickness of the strips of metal without the use of gauges. Gold strips are heated in an iron heater by steam, and waxed with a cloth dipped in melted wax, and the silver strips are coated with tallow by means of a brush. The draw bench is used for both metals, and trial pieces are cut from every strip and their weight tested, preparatory to the cutting of the whole.

The cutting processes are very simple and efficient, consisting of a shaft moved by pulleys, and a $2\frac{1}{2}$-inch belt, with a fly-wheel of small diameter but sufficient in momentum to drive the punch through the slip of metal by means of an eccentric of $\frac{3}{8}$-inch, at the rate of 250 pieces per minute, which skilled hands can readily accomplish and continue until the slip is exhausted. The annealing during the rolling of the ingots into slips is performed in copper cases, in muffles of fire-clay and brick, heated by anthracite coal, three muffles or hearths being kept at a bright red heat by one fire-grate or furnace, and the distribution and intensity regulated by dampers. These annealing furnaces are recent in their construction and very satisfactory in operation; they are heated by anthra-

cite at the cost of about one-fourth the expense of the wood previously employed.

The whitening of planchets is performed as usual by inclosing the gold in luted boxes, and by exposing the silver in an open pan, to the heat of a simple furnace with wood fuel; the drying and sifting after the action of dilute sulphuric acid, is rapidly and effectually accomplished by a rolling screen—one portion of which consisting of a pair of closed concentric cylinders, between which high-pressure steam is admitted. The blanks, with a sufficient quantity of light wood saw-dust (linden or bass wood is the best), being introduced into the interior cylinder, a revolving motion is given to it by the engine for a certain time; the door is then opened and the blanks and saw-dust gradually find their way into the wire screen, by which they are separated, the movement being continued until the separation is complete, when the blanks are discharged at the end of the machine. An arrangement exists by which a slight inclination is given to the machine so as to direct the motion of the blanks towards the discharging end.

The milling machines are, I was informed, peculiar to this mint, and are in a great measure original, the operation being performed by a continuous rotary motion, with great rapidity and perfect efficiency, varying in rate according to the denomination of the coin, between 200 and 800 pieces per minute, and at the same time separating any pieces that are notably imperfect.

It must be understood that the operation here termed "milling," is merely for the purpose of thickening and preparing the edge, so as to give a better and more protective border to the coin, the ornament or reed, commonly known I believe in this country as "milling," being given to the piece by the reeded collar of the die in which the piece is struck.

The coining presses, 10 in number, and milling machines are worked by a high-pressure horizontal steam-engine, made from the design and under the direction of the present chief coiner, in the workshops of the establishment, in 1838.

The presses are three sizes, the largest applicable to the striking of silver dollars and double eagles:—the second to pieces of medium value:—and the smallest to the dime, half dime, and 3-cent pieces. The first is usually run at the rate of 80 per minute, the last at 104 per minute,—the average rate of the whole is 82 per minute. This rate can be increased if required.

If all the presses were employed in coinage at the usual rate, they would strike in one day (9 working hours) 439,560 pieces; and if employed upon gold, silver, and copper, in the usual manner, and on the usual denomination of coin, they would amount in value to $966,193.

During the past year, on one occasion, 8 of the presses were run 22 out of 24 consecutive hours, and coined in that time 814,000 pieces of different denominations of coin.

These presses have been made principally in the workshops of the Mint. They possess in common with the presses of Uhlhorn, in Germany, and Thouellier, in Paris, the advantage of "the progression lever," "le genou" or "toggle joint," a mechanical power admirably adapted to this

operation; but in almost every other particular they are original in arrangement, being the result of experience, beginning as far back as 1836.

In order to supply these presses, various means have been devised; among them, and not the least important, is the "shaking box," in which advantage is taken of a disposition observable in similar bodies, or bodies of similar form, to arrange themselves in similar positions. This is a box, whose bottom is constructed with parallel grooves adapted to the size of the blanks or planchets to be arranged. A quantity of them is thrown indiscriminately into the box, which is then quickly shaken in the direction of the grooves, the pieces immediately lay themselves side by side, in parallel rows, from which they can easily be lifted in roleaux as required to be passed to the feeding tubes of the mills or presses.

It is very evident to all visiting the establishment that such a large number of pieces could not be coined and manipulated by such a limited number of hands without the aid of some labor-facilitating arrangements, one of the most worthy of remark of which is, the method of counting the pieces coined—if counting it can be called, for in principle it is a measuring machine. The arrangement of this counting frame, or tray, may be understood from the following sketch of its construction:

A board or tray of such dimensions as may be required, is divided by a given number of parallel metallic plates dissected into its plane and slightly elevated above it, the edges of which rise no higher than the thickness of the coin for which it is intended. The board is of such a length as will admit of a few more than the required number of pieces to be laid longitudinally in the rows, and is divided across and at right angles with the rows, and hinged at a point opposite to a given number. One of those employed by this department, counted 1000 pieces, that is to say, it had 25 parallel grooves or rows sufficently long to receive 45 pieces. Now, having thrown on this board a large excess of pieces, it is agitated by shaking until all the grooves are filled, and then inclined forwards until all the surplus pieces have slid off, one layer only being retained by the metallic lédge; the hinged division is then suffered to fall, which at once throws off all but the 45 pieces in the length of each row. This operation, somewhat difficult and tedious to describe, is performed in a few seconds, and results in retaining on the board 1000 pieces, each piece exposed to inspection, and the whole accurately counted without the wearisome attention—so likely to result in error—required under usual circumstances.

The very large number of pieces coined during the last year has been counted exclusively by two female manipulators, assisted by a man who had the duty of weighing them in addition as a testing check. The same amount of labor by ordinary means could not have been performed with fewer than thirty or forty hands, to say nothing of inferior accuracy. This machine was originally arranged and patented by the late R. Tyler, coiner of the New Orleans Branch Mint, but materially improved in its application and construction by Mr. Franklin Peale.

The balances of the Mint of the United States have received the attention necessary to an instrument of such importance in mint operations. They have been arranged and made generally in the workshops of the establishment, and operate entirely to the satisfaction of the department.

It is not necessary to enter into details of their construction, as a full and minute description is given in the *Journal of the Franklin Institute* for July, 1847. I, perhaps, ought to mention that since that appeared, some slight improvements have been made by inclosing all but the stirrups and pans in glass, by these means excluding dust and protecting them from the influence of air currents.

In concluding this brief sketch of the practical working of the two most important departments of the United States Mint, I cannot omit a reference to the very excellent remarks of the chief coiner on the employment of females in some of the operations in his department. This, he informed me, had generally excited the surprise of, and been commented upon, by foreigners, who had visited the Mint. His experience, however, had led him to believe, that in places of trust, where no great physical exertion was called for, but where accuracy and strict integrity were of first importance, the moral perceptions of the female, generally stronger and of a higher standard than in the man, would qualify her as his substitute, and thus, while opening a new field of labor for the occupation of females, would strengthen their claims to it by the superior accuracy and economy of their work.

For the Journal of the Franklin Institute.

The Mammoth Steamer of Great Britain.

The following comprise most of the essential elements of this monster iron vessel, building by Messrs. Scott Russell & Co., for the Eastern Steam Navigation Company:

Length,	675 feet.
Beam,	83 "
Depth of hold,	60 "
Draft of water at load line,	30 "

This vessel is to be propelled by four steam engines, two of them connected with side water wheels, and two with a screw propeller.

The water wheel engines are to be of 1000 horses; oscillating cylinders, 74 inches diameter, by 14 feet stroke of piston.

The screw engines are to be of 1500 horses, 84 inch cylinder, and are to be made by Messrs. Bolton & Watt.

The boilers will have 100 furnaces.

The hull is divided into water-tight compartments of 60 feet. The weight of plates will be 10,000 tons, and the number of rivets 3,000,000. The plates at bottom are to be one inch thick, and three-quarters at sides and top.

The frame is to be plated within as well as outside the ribs, up to the water line.

Water wheels are to be 60 feet in diameter.

Vessel to accommodate 600 first class and 2000 second and third class passengers, and to carry 12,000 tons of coal. C. H. H.

For the Journal of the Franklin Institute.

Particulars of the Steamboat Cuba.

Hull built by Samuel Sneden, Greenpoint, L. I.; Machinery by Pease & Murphy, New York; Intended service, Mobile to New Orleans.

Hull.—		
Length on deck, from fore part of stem to after part of stern post, above the spar deck,		250 feet.
Breadth of beam at midship section,		32 " 8 inches.
Depth of hold,		9 "
Draft of water at load line,		6 " 6 "
" " below pressure and revolutions,		6 "
Tonnage, custom-house,	800.	
Masts and rig,	foresail and jib.	
Engine—Vertical beam.		
Diameter of cylinder,		56 inches.
Length of stroke,		10 feet.
Maximum pressure of steam in pounds,	80.	
Cut off,	$\frac{5}{8}$.	
Maximum revolutions per minute,	18.	
Boiler—One—Flued.		
Length of boiler,		35 feet.
Breadth "		13 " 9 inches.
Height " exclusive of steam chimney,		13 " 3 "
Number of furnaces,	3.	
Breadth of "		3 " $8\frac{1}{2}$ "
Length of grate bars,		7 " 8 "
Number of upper flues,	6.	
Internal diameter of flues,		19 and 21 ins.
Heating surface, (fire and flues,)		1700 sq. feet.
Diameter of smoke pipes,		5 feet.
Height "		36 "
Description of fuel,	wood.	
Combustion,	Natural draft.	
Paddle Wheels.—		
Diameter,		30 feet.
Length of blades,		8 "
Depth "		2 " 2 inches.
Number "	28.	

Remarks.—Floor timbers at throat, *molded*, 15 inches;—*sided*, 5 inches;—distance of frames *apart at centres*, 24 inches. Frame strapped with diagonal and double laid iron straps 4 by $\frac{1}{2}$ inch. C. H. H.

For the Journal of the Franklin Institute.

Particulars of the Steam Tug Leviathan.

The following particulars possess more than ordinary interest, inasmuch as they contain the exact dimensions and reliable elements of performance of the fastest sea steamer in American waters; and if this statement should appear unreasonable to any one, he is referred to the cross area of a single run of her water wheel blades compared to her midship section, which bears the relation of 39 to 176, and this, too, with a velocity given to their periphery of 23 statute miles per hour; the deduction to be made from this for slip of wheel, is left to your profes-

sional readers; for, as I have no means of arriving at it by observation, they might be unwilling to take my estimate of it; of one fact, however, I can furnish them, and that is, that this vessel being employed daily in the towing of vessels in and out of the harbor of New York, has had the opportunity, upon many occasions, of testing her speed with all the steamers that trade to that port; and still, up to this time, she has never found a troublesome competitor.

Hull built by Eckford Webb; machinery by Allaire Works, N. York. Intended Service, towing.

Hull.—		
Length on deck, from fore part of stem to after part of stern post above the spar deck,		179 feet.
Breadth of beam at midship section, molded,		29 " 3 inches.
Depth of hold to spar deck,		11 " 6 "
Length of engine and boiler space,		71 "
Tonnage, Custom House,	500	
Engine.—Vertical beam.		
Diameter of cylinder,		60 inches.
Length of stroke,		10 feet.
Maximum pressure of steam in pounds,	30	
" revolutions per minute,	22	
Point of cutting off,	$\frac{1}{2}$	
Draft of water at above pressure and revolutions,		8 feet.
Area of immersed midship section at this draft,		176 "
Diameter of water wheel,		29 " 4 inches.
Length of blades,		8 " 4 "
Depth of blades,		2 " 4 "
Number of blades,	21	
Boilers.—Two.—Return flued.		
Length "		28 feet.
Breadth "		10 "
Height " exclusive of steam chimney,		9 " $10\frac{1}{2}$ ins.
Number of furnaces,	4	
Width "		4 " 4 "
Length of grate bars,		7 " $7\frac{1}{2}$ "
Number of flues,	15	
Internal diameter of flues, lower tier, 8 of		$12\frac{1}{4}$ "
" " " " " 2 of		18 "
" " " upper return, 5 of		16 "
Length of flues, lower tier,		15 feet $8\frac{1}{2}$ inches.
" " upper tier,		21 " 9 "
Diameter of smoke pipe,		5 " 5 "
Height " (above grate bars,)		64 " 5 "
Heating surface, fire and flues,		2927 sq. ft.
Combustion,	Natural draft.	
Capacity of coal bunkers, in tons of coal,	30	
Consumption of coal per hour,	2240 lbs.	
Draft of water at load line,		8 feet.
Frame of white oak and chestnut.		
Floors molded,		13 inches.
Floors sided,		6 "
Distance of frames apart at centres,		2 feet 4 "
Masts and rig,	None.	
Description of coal,	Anthracite.	

Remarks.—Coppered. C. H. H.

Method of Representing Objects by Printing Directly from them.
By Felix Abate, of Naples.*

This invention constitutes a new art, by means of which natural and artificial objects can be represented and imitated by printing directly from the objects themselves upon any suitable substance. The specimens submitted to the inspection of the Society at its last meeting, are imitations of veneering wood, some simple, and some ornamented with inlaid work, made upon wood, calico, and paper.

Before entering into the details of this invention, I may perhaps be allowed to state, in order to prevent mistakes, that it is essentially different from the well-known invention under the name of *Phytoglyphy*, or Nature-printing, patented in England by Messrs. Bradbury & Evans, and practised at the Imperial Printing Office at Vienna, and which consists in taking impressions in lead or other metals, or gutta percha, from natural objects, making electro-plates from such impressions, and then printing with these plates in the usual way. The principle of my invention dates from an epoch anterior to the Great Exhibition of 1851, as I exhibited on that occasion the first specimens of a particular application of it, called *Metallography*. For this branch of the art, I was rewarded with the prize medal. An idea of this art will be obtained from the following notice of the principles and processes upon which it rests:

The art of *metallography* consists in printing from engraved wood blocks upon *metallic surfaces*, so as to produce imitations of figures and ornaments inlaid in wood. This effect is obtained by using, as a printing menstruum to wet the block with, solutions of such metallic or earthy salts as are decomposed when brought into contact with certain metals, and produce, through an electro-chemical action, an adhesive precipitate of a colored metallic oxide, or any other chemical change upon the metal. Such are the salts of copper, antimony, &c., upon zinc, tin, silver, &c.; the hydrosulphuret of ammonia upon copper and brass.

There are two principles at work in this branch of the art—the one is the chemical action just referred to; the other, which is the foundation and the keystone of the invention in its most general sense, rests in the porousness of the printing object, which causes the absorption of the wetting fluid, and yields it, under the action of pressure, in quantity for each point proportionate to the capacity of the pores; so that if any chemical change is wrought upon the impression, to produce a coloring of it, this coloring, by its different shades, makes a true representation of the printing object.

The application of the invention to printing upon vegetable substances instead of metallic surfaces, required the introduction into the process of some new principle to produce that chemical change which, in metallography, is spontaneous. I devised, for that purpose, two principles, which, by different means, lead to the same results. One of these principles I borrowed from the art of dyeing. It consists in the peculiar actions that the salts, acids, and alkalies have upon each other, and upon vegetable coloring matters. It is upon these actions the processes of

* From the London Mechanics' Magazine, July, 1854.

mordant and discharge printing on textile manufactures rest. The surface of the printing object is slightly wetted with the acting fluid, which is then well wiped off from the surface; the impression is then taken, which, by combining with a previous or a subsequent dying of the printed surface, instantaneously appears. The other principle I found in heat, that is, in the coloring action that this most powerful agent of Nature has upon vegetable substances when acted on by acids, which coloring, I believe, is the effect of an accelerated carbonization of the surfaces of these substances produced by the acid. I think I may properly call this art THERMOGRAPHY, or the art of printing by heat.

From the following description of the process, it will be remarked—perhaps with some degree of surprise—the excessive sensitiveness of vegetable substances under the joint action of acids and heat, so that an infinitesimal dose of the former, and an instantaneous application of the latter, are sufficient to produce the most striking effects. The process is as follows:

Suppose a sheet of veneering-wood be the object from which impressions are to be taken; I expose the wood for a few minutes to the cold evaporation of hydrochloric or sulphuric acid, or I slightly wet it with either of these acids diluted, and then well wipe the acid off from the surface. Afterwards it is laid upon a piece of calico or paper, or common wood, and by a stroke of the press an impression is taken, which is, of course, quite invisible; but by exposing this impression, immediately after, to the action of a strong heat, a most perfect and beautiful representation of the printing wood instantaneously appears. In the same way, with the same plate of wood, without any other acid preparation, a number of impressions, about twenty or more, are taken; then, as the acid begins to be exhausted and the impressions faint, the acidification of the plate must be repeated as above, and so on progressively, as the wood is not in the least injured by the working of the process for any number of impressions. All these impressions show a general wood-like tint, most natural for the light-colored woods, such as oak, walnut, maple, &c.; but for other woods that have a peculiar color, such as mahogany, rosewood, &c., the impression must be taken, if a true imitation be required, on a stuff dyed of the light color of the wood.

It must be here remarked, that the impressions, as above made, show an inversion of tints in reference to the original wood, so that the light are dark, and *vice versa*, which, however, does not interfere with the effect. The reason of it is, that all the varieties of tints which appear in the same wood are the effect of the varying closeness of its fibres in its different parts, so that where the fibres are close, the color is dark, and light where they are loose; but in the above process, as the absorption of the acid is greater in proportion to the looseness of its fibres, the effect must necessarily be the reverse of the above. However, when I wish to produce the true effect of the printing wood, I alter the process as follows:—I wet the surface upon which the impression is to be taken with dilute acid, and then I print with the veneering wood previously wetted with diluted liquid ammonia; it is evident that in this case the alkali neutralizing the acid, the effect resulting from the subsequent action of heat will be a true representation of the printing surface.

Such is thermography, or the art of printing by means of heat. Now it is nothing but natural to anticipate in regard to this art, as well as to the other above-described process for printing directly from objects, that they will afford most important services to the natural, botanical, mineralogical, and anatomical sciences; as it is by their means that the internal structure of bodies is unveiled to the eyes of the philosopher, and the wonders of nature in its inexhaustible varieties are indefinitely multiplied, to be subjected to the investigation and to serve the gratification of mankind.

But the new art will prove not less useful to the decorative arts, particularly in its application to produce imitation of rare and costly woods, as well as of works of art, mosaic and inlaid work applicable for paper-hangings, or for furniture in the place of veneering, these imitations being produced at an exceedingly low cost, while they rival in perfection the original objects, enabling those whose means are limited to obtain decorations at once cheap and in good taste.—*Journ. Society of Arts.*

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*The Navigation of Iron Ships.**

In his paper, read before the British Association on this subject, Dr. Scoresby observed, that since the first promulgation of his views at the British Association in Oxford, in 1847, he had to contend with either the *denial* or *non-reception* of them from the principal body of scientific men engaged in the consideration of compass adjustment and compass action in iron ships. But it was now most gratifying to find, from the paper of Mr. Archibald Smith, a gentleman eminent as a mathematician, and having all the records of Her Majesty's ships, as to compasses, at command, that every essential principle for which he contended, as to the principles which affect the development, destruction, and changes in the magnetism of iron ships, is admitted and supported. These principles, so supported by Mr. Smith, might be thus enumerated:—1. That the magnetism of iron ships in its action on the compass, may be represented by a vertical and a horizontal iron or magnetic bar swinging round a compass; a mode of illustration which he, Mr. Smith, had adopted some years ago, and described in lectures, as well as in his publication of 1851. 2. That changes in the magnetic distribution and compass action in iron ships, which he predicted, do take place. 3. That the changes take place in a ship's magnetism by change of magnetic latitude, a fact inferred from the Admiralty observations which his (Dr. Scoresby's) experiments satisfactorily elucidated as a necessary consequence of the resistance in iron to change in regard to the denomination of *retentive* magnetism. 4. That there are influences in a ship derived from the varieties of form and position (relatively to the compass) of particular masses of iron, which may act as *natural correctives.* 5. That the plan of correcting the duration of iron ships by *fixed magnets* (unless in places or limited voyages) is unsafe, and in going to southern regions aggravates the error. 6. That the twisting of the iron materials of a ship will tend, especially in ships

* From the London Mechanics' Magazine, October, 1854.

recently launched, to alter the magnetic action on the compass. 7. That it requires time to effect the changes in a ship's magnetic distribution, which ultimately may, in regions distant from the place of building, be effected. And the whole of the results plainly go, he believed, to the establishment of a proposition, of the accuracy of which he has long endeavored to convince those interested in the navigation of iron ships, that the magnetism of such ships is, in all its qualities, changeable; the most enduring, or apparently fixed, which he has denominated *retentive magnetism*, being of a description changeable under severe straining and mechanical violence. No large changes may be expected under the following circumstances:—1. In iron ships long in use, and ordinarily pursuing the same voyage, because extreme distribution gets shaken down, as it were, in a medium or average state. 2. Great changes do not take place in the retentive magnetism (by far the greater portion) in latitudes not farther south than the Mediterranean, because, 3, in ships trading in the channels, or east and west to America, the liability to new or unexpected changes greatly diminishes. In such cases, an intelligent captain, observing the changes, duration, alteration, and allowances, may generally run with great confidence. Experience will establish the effect of circumstances in this case. Suggestions:—1. A standard-azimuth compass to be placed on a high pedestal, where (on the Admiralty plan) a position of small duration may be found. 2. A compass at masthead he believed best of all for reference, by which the great body of error will be demonstrated. 3. The wheel-compass required for ships engaged in the home trade, or traversing mainly parallels of latitude not southward of the Mediterranean, if adjusted with magnets and pieces of iron, may not be then unsafe, where reference may always be had to the standard for verification. 4. No standard compass in great distances. 5. Care in selection of compasses, to have ample directive force. His improvements had trebled the directive force, weight for weight, of the compasses used in the Navy up to 1839 or 1840. 6. Captains must be made to take observations for verifying their compasses by azimuth compasses, stars, position of land—a subject of examination. 7. Captains should have a special knowledge for the charge of iron ships, for here, in addition to the ordinary dangers of navigation, is a new source of error and misguidance, as to which, it is most important, he should never be thrown off his guard. 8. Rules of caution.

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*On some Peculiarities of the Magnetic Field.**

Professor Tyndall accompanied the reading of this paper with experiments adopted for the purpose of better elucidating the subject. He said, a piece of soft iron suspended between the flat poles of an electro-magnet set its largest dimensions from pole, the residual magnetism of the cores being sufficient to produce the effect. This is the normal deportment of magnetic bodies, but it is by no means universal. By mechanical agency, by pressure for example, the structure of a magnetic body can be so modified that its shortest horizontal dimension sets from pole. Pro-

* From the London Mechanics' Magazine, October, 1854.

fessor Tyndall exhibited actions of the kind where the body operated on was compressed magnetic dust. In such a body two opposing tendencies were at work,—the tendency due to length, which sought to set the length axial, and the tendency due to structure, which sought to set the line perpendicular to the length axial. Between the flat poles the latter tendency was predominant, but between pointed poles this was not the case; here the attraction of the ends of the magnetic mass constituted a mechanical couple of sufficient strength to overcome the directive tendency which was due to structure, and to draw the mass into the axial line. But in raising or lowering the body operated on out of the sphere of this local attraction, by bringing it into a position where the distribution of the magnetic field resembled that existing between the flat poles, the body forsook the axial position and turned into the equatorial. The complementary phenomena were exhibited by bismuth. A normal bar of this substance sets its length at right angles to the line from the poles; but Professor Tyndall exhibited a bar of this substance, which set between the flat poles exactly as a magnetic body. Such a bar, however, between the points set equatorial. On raising it or lowering it, however, it forsook the equatorial position and set axial. In this case the local repulsion of the ends between the points caused the bar to set equatorial, the influence of length thus predominating over the influence of structure; but removed from the sphere of this local action, the directive tendency of the mass triumphed and caused the bar to set axial. The bar in this case was cut with its length at right angles to the planes of most eminent cleavage of the bismuth. It is a proved fact, that these planes, while the influence of form is annulled, always set at right angles to the line piercing the poles, and hence where they are transverse to the length, the bar will set axial. These phenomena were examined in a great number of cases; bars were taken from substances possessing a directive tendency, and it was so arranged that the directive tendency due to structure was always opposed to the influence of length; between the points the former tendency succumbed to the latter, while between the flat poles, or above and below the points, the former was triumphant. It is amusing to observe the strife of these two tendencies in substances possessing a strong directive action. A plate of crystallized carbonate of iron, when properly suspended, will wrench itself spasmodically from one position into the other, and find rest nowhere. The simple law which governs all these actions is, that if the body, cut as above, be diamagnetic, its length sets equatorial between the points, but above and below them axial. If the body be magnetic it sets axial between the points above and below equatorial. Hence, the rotation of a magnetic body, on being removed from between the points, is always from axial to equatorial; while the corresponding rotation of a diamagnetic body is always from the equatorial to the axial. The deportment of wood in the magnetic field was next described. Nearly sixty specimens examined by Professor Tyndall were all diamagnetic; each of them was repelled by the poles of the magnet; cubes of each when suspended with the fibre horizontal set between the excited poles, the fibre perpendicular to the line which unites the poles. Thinking that wood, on account of its structure, would exhibit those directive phenomena which had been demonstrated in the

case of the bodies mentioned at the commencement, bars were taken from nearly forty kinds of wood, the fibre being at right angles to the length of the bar; in the centre of the space, between two flat poles, all those bars set their lengths from pole to pole. But Professor Tyndall afterwards observed the remarkable fact, that homogeneous diamagnetic bodies did the same. Bars of sulphur, of salt of hartshorn, of wax, and other diamagnetic substances, when suspended in the centre of the space between two flat poles, set their lengths from pole to pole. Now, as diamagnetic bodies always take up the position of weakest force, it was proved by these experiments, and corroborated by others not cited here, that the true force of the centres of two flat poles, contrary to the general opinion hitherto received, was the line of minimum force.

The Rev. Dr. Scoresby stated that, by subjecting to force ordinary magnets of hardened steel, as by suddenly bending them, or striking them in particular modes, they may have their poles reversed or be deprived of their magnetism, or hardened non-magnetic steel may be instantly rendered magnetic; and he considered that these facts, which he had long since made public, should be kept before the mind in such investigations as the very original and interesting facts just brought under the notice of the Section.—Professor Faraday, after very briefly, yet lucidly, explaining to the Section the leading distinctions between paramagnetic and diamagnetic bodies, and their behavior in the magnetic field, said, that it was conceded on all hands that the explanation was erroneous which Plücker had given of the phenomena which he first discovered connected with the branch of research to which Professor Tyndall had just been directing their attention, and which he was so ably hunting down. But when he said the original explanation of Plücker was erroneous, he did not mean that as the slightest disparagement to that philosopher. It was well understood by all who had any pretensions to scientific knowledge since the days of Bacon, that it was through the mist of error that the most important discoveries had to be made, and that in pursuing any research it was much better in the first stages of the inquiry to have erroneous views, than to be without any views that would tend to connect the scattered facts. For his part, he was not ashamed to own that he was a learner, and that in almost every instance it was through the clouds of error that he arrived at the conclusions which satisfied him most. And as his mathematical skill and acquirements were by no means such as to entitle him to despise instruction, he should feel particularly grateful to his mathematical friends present, Dr. Whewell and others, if they would explain to him and to the Section the law of distribution of the magnetic force in the magnetic field, if it was known. Dr. Whewell explained how the force would be distributed upon the old theory of magnetic lines; but he said he was aware, and he believed it was now generally admitted, that this theory must be greatly modified, if not given entirely up. But as he saw Professor W. Thomson in the Section, who had paid particular attention to the development of the mathematical theory of magnetical and electrical forces, he trusted that that gentleman would favor the Section with his views.—In answer to Professor Faraday's question, as to the mathematical conditions under which a uniform field of magnetic force may be produced, Professor W.

Thomson remarked, that the mathematical theory of the distribution of force both afforded a remarkably simple and definite general answer, and pointed out the most convenient practical means of fulfilling these conditions, either approximately or rigorously. For, in the first place, it is strictly demonstrable that if the force be rigorously uniform in some locality, in the neighborhood of any kind of magnet or electro-magnet, through even one one-thousandth of a cubic inch, in fact, through any finite bulk, however small, it cannot but be vigorously uniform through every portion of space to which it is possible to go from that locality without passing through the substance of the magnet. Hence, although between flat poles, such as Mr. Faraday first introduced for obtaining uniformity of force, we have in reality a most excellent practical approximation to a uniform distribution of very intense magnetic force, through a space of several cubic inches, in a locality not only visible, but in every way convenient for experimental purposes; yet it is absolutely impossible that the force can be rigorously uniform through the smallest finite bulk of the magnetic field in any such arrangement, or, generally, in any locality external to a magnet. If an experimenter wants a rigorously uniform field of force, he can only have it in the interior of his magnet; and he must be contented not to see the action he experiments on at the time it is being produced, unless he will follow the example of Professor Faraday, who 'went into a hollow cubical conductor of electricity, and lived in it,' and so was enabled to observe some most interesting and important fundamental properties of electrical force. It would be easy to make a hollow electro-magnet, in the interior of which the experimenter could observe with the minutest accuracy the bearings of all kinds and shapes of bodies in a vigorously uniform field of force. All that is necessary to make such a conductor is to take a hollow *papier-maché* globe, say six feet in diameter, and roll a galvanic wire over its surface in a succession of close parallel circles, having their planes at equal distances from one another. A hollow non-magnetic body, of any shape, cubical for instance, may have a rigorously uniform distribution of magnetic force produced in its interior by a suitable distribution of galvanic wire over its surface, determinable, according to the form of this surface, by the mathematical theory from which these results are stated. But it would be difficult, perhaps practically impossible, to get a sufficient intensity for exhibiting the forces experienced by diamagnetic or weakly paramagnetic bodies in a uniform field of such extent that the operator could himself enter it; and experimenters must be contented either with approximations to uniformity, such as in the arrangement with flat poles, so successfully used by Professor Tyndall in the beautiful experiments which he had exhibited to the Section, or they must arrange to test effects in the interior of hollow electro-magnets without seeing them at the time they are taking place. Interesting questions, which the mathematical theory answers decisively, had also been asked regarding the minimum condition of the central line in a field between opposed flat poles, of two cylindrical soft-iron bar magnets, and the effects of rounding off the edges of these poles. It appears that, if we consider the intensity of the force in a plane perpendicular to the magnetic axis through the centre of the field, we find it increasing from the central point to a certain circle of

maximum intensity, beyond which it diminishes gradually and falls to nothing at an infinite distance. If the edges of the cylinders be rounded off, the circle of maximum intensity contracts, its centre always being a point of minimum intensity, until a certain degree of convexity of the poles is attained, when the circle of maximum intensity becomes contracted to a point—the central point of the field—which will then be a point of maximum intensity (the central minimum being eliminated,) and will continue a maximum, as regards all points in the plane through it, perpendicular to the axis, for any less flat or more prominent or pointed forms of poles. No form of rounded poles, by doing away with maximum or minimum points, can possibly give a uniform distribution of intensity through ever so small a finite bulk of the field. *Proc. Brit. Association.*

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*M. Picault's Mode of Making Razors.**

He first prepares plates of cast steel, laminated to the thickness which the blades are to have, and having two opposite sides forged to a coarse edge. These plates are placed under a shears, which at one cut produces a blade. Upon these blades M. Picault stamps his mark, and by the aid of a cutting hammer he impresses a number of striated or grooved lines upon the two surfaces of the blade where it is to be fitted into the back. The back itself is formed of soft cast iron, planed and polished so as to retain none of the roughness of the casting. A groove is formed by a simple mechanical process in one of the edges, and into this is fitted the blade previously prepared. The blade and back thus joined are placed in a swage or stamp having the form of the back, and subjected to a considerable pressure by means of a lever, the effect of which is to fix the blade in the groove, where it is held tightly by means of the grooves cut in the blade as already mentioned, and into which the soft cast iron is, as it were, squeezed. There only remains the operation of grinding to complete the razor, and this is done exactly in the same way as with razors formed in one piece.

This system of manufacture appears to offer the following advantages: 1st, As to economy, in the reduction by nearly one-half of the weight of steel employed; in the fuel and labor at the forge, which become in this method insignificant; in the absence of any operations of filing down, &c., inasmuch as each blade comes from the shears fully formed; and in the rarity of failure in the operation of tempering, owing to the almost uniform thickness of the blades, which allows them to be heated to the exact point necessary for a good temper, and to cool more equally in the water. 2d, As to quality in the steel employed; in the simplicity of the forging, which is confined to the closing up of the pores of the steel upon the cutting edge of the blade, and does not necessitate the subsequent evils of cutting away the hardened surface which thick blades require; and in the fact, that in the operation of tempering, the blade being of an almost uniform thickness, the cutting edge is not subject to be burnt as in the ordinary process. The idea of applying artificial backs to razors is not new, but hitherto the methods proposed to effect it have been un-

* From the London Artizan, August, 1854.

successful, whilst M. Picault has completely resolved the problem. The only objection which can apparently be raised against his system of manufacture is, that the joining of the back and the blade may retain humidity, and rust after some time. This objection would, however, apply to all razors with artificial backs, and may be obviated by a little care in using them.—*Bulletin de la Société d'Encouragement, September*, 1853, p. 499.

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*On the Deviation of the Magnetic Needle Peculiar to Liverpool.**

This paper was read by Sir John Ross, the celebrated Arctic explorer. He said:—"Ever since the year 1799, when my attention was first directed to the deviation of the magnetic needle, I have lost no opportunity of making observations in many parts of the globe, on the interesting phenomena appertaining to that influence—a statement of which has been published by me in the narrative of my first two voyages of discovery to the Arctic regions. Since which my attention was called to the frequent losses of ships consequent on the fallacious system adopted by the Admiralty, called 'adjusting the compass,' at Gravesend and other places; and after the loss of the *Birkenhead*, I felt it my duty to publish a pamphlet, which, although dedicated by permission to the First Lord of the Admiralty, did not at once obtain their Lordships' approbation, inasmuch as it exposed the absurdity of the system then in practice under the superintendence of a naval officer attached to the Admiralty. But I maintained the truth of my statement; and, after some correspondence on the subject, my assertions were found to be correct, and, consequently, the office of Superintendent of Compasses was abolished, and circulars issued by the Admiralty, not only ordering a monthly examination of the deviation, but that such observation should be instituted at every change of the ship's position, and on every circumstance which was known or supposed to affect the ship's deviation, or local attraction, which is now admitted to be of infinite service. But my attention has for some time been called to the fact of ships sailing from the port of Liverpool, after having been swung in the Mersey, to obtain the amount of deviations, or, as it is called, *to have their compasses adjusted*, that immediately on their proceeding on their voyage, it was found that the deviation observed in the Mersey was incorrect, and there have been lamentable instances of shipwreck in consequence. It has occurred to me that this untoward circumstance is very easily explained. The fact is, that the Mersey is not a locality eligible for ascertaining the true deviation of the magnetic needle, the ships being in a position between establishments in which large masses of iron are deposited, which must have an influence on the magnetic needle during the evolution of swinging the ship, while the embarkation of passengers with their luggage, or anything else subsequent to that process, cannot but have the effect of producing a false and dangerous result to the observations. But this evil is not without an effectual remedy, which is within the power of every captain of a ship after he has left the port of Liverpool, and which will be found in the following pro-

*From the London Mechanics' Magazine, October, 1854.

posals. It is proposed that the present method of swinging the ship in the Mersey shall be continued; and, in order to obtain a verification or a correction of results observed at that time, it is proposed to place on the sand hills of Rockland (near the Rock Lighthouse,) two posts or beacons, true north and south of each other, in the positions best seen near the red buoy of the Rock Channel, when the ships passing will be steering about true west, or west-north-west, by compass. When these two objects can be brought into one—that is, due north of each (both being south of the ship,) either a verification of the deviation that was observed in the Mersey, or the amount of difference to be taken into consideration or account on that particular point of the compass, will be shown, from which a calculation may be made in approximation of the other points; and if, further on, two other posts were erected on the magnetic meridian, the ships, on passing them, when in one with each other, could observe the exact amount of the deviation, either in the increase or the diminution of the variation on the course of the ship, keeping in mind that it will be on the south point of the compass that the observations will be made. Posts placed due south of Lizard Lighthouse would be useful, and also on the magnetic meridian. But all posts or beacons denoting the true north or south bearings, and those further off denoting the magnetic meridian, should be painted of different colors. The former—that is, the true or nearest—should be red, while the latter, showing the magnetic meridian, should be chequered. Great Ormshead and Holyhead should have beacons placed on them which would be observable to ships both outward and homeward bound. *Proceed. Brit. Association.*

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*On the Means of Realizing the Advantages of the Air-Engine.**

This paper was read by Mr. W. J. Macquorn Rankine, C. E. The paper consisted of four Sections. In the first were explained the two fundamental laws of the mechanical action of heat, and their application to determine the efficiency of theoretically perfect engines, working between given limits of temperature; and it was shown that, as the efficiency increases with the distance between those limits; and, as it is easy to employ air with safety at temperatures far exceeding that at which the pressure of steam would cease to be safe and manageable, the maximum theoretical efficiency of air-engines, consistent with safety, is much higher than that of steam engines. For example, at the temperature of 650° Fahr., at which the air-engine has been successfully worked, the pressure of steam is 2100 lbs. on the square inch, while that of the air is optional, being regulated by the density at which the air is employed.

In the second section the various causes of waste of heat and power in steam engines were classified, and the actual efficiency of steam engines compared with their maximum theoretical efficiency, and also with the maximum actual efficiency which may reasonably be supposed to be attainable in the steam engine, by means of any probable mechanical improvements.

* From the London Mechanics' Magazine, October, 1854.

The following are estimates of the consumption of bituminous coal, of a specified quality, per horse power per hour:

1. For a theoretically perfect engine working between such limits as are usual in steam engines, ...	1·86 lbs.
2. For a double acting steam engine improved to the utmost probable extent, ...	2·50 "
3. For a well constructed and properly worked ordinary double acting steam engine, on an average, . . .	4·00 "

In the third Section, the causes of waste of heat and power, in air-engines, were classified in a manner analogous to that applied to steam engines; and the actual efficiencies of those previous air-engines, as to which satisfactory experimental data have been obtained, namely, Stirling's engine, and Ericsson's engine of 1852, were compared with the efficiencies of theoretically perfect engine working between the same limits of temperature, the results being as follows, so far as they relate to the consumption of coal of the specified quality per horse power per hour:—

	Actual Consumption.	Consumption of a theoretically perfect Engine.
	lbs.	lbs.
Stirling's Engine, . .	2·20	0·73
Ericsson's Engine of 1852, .	2·80	0·82

It is thus proved that an air-engine has actually been made to work successfully and to realize an economy of fuel considerably superior to that of ordinary steam engines; and, in fact, surpassing the utmost limit to which it is probable that the economy of double-acting steam engines can ever be brought.

Stirling's engine, as finally improved, was compact in its dimensions, easily worked, not liable to get out of order, and consumed less oil, and required fewer repairs than any steam engine; still the advantages shown by that engine over steam engines, were not so great as to induce practical men to overcome their natural repugnance to exchange a long-tried method for a new one. Another circumstance caused Stirling's and Ericsson's engines to meet with neglect from scientific men: namely, that both were by some persons represented as instances of *power created out of nothing*, the popular delusion commonly called '*the perpetual motion.*' It is shown, that Stirling's air-engine, as compared with a theoretically perfect air-engine, wasted two-thirds of its fuel; and Ericsson's somewhat more.

Two obvious and powerful causes of that waste of fuel were traced:

1. Deficiency in extent of heating surface. 2. The communication of heat from the furnace to the working-air at those periods of the stroke when it is not performing work.

The necessary conclusion is, that the more completely we remove those two causes of waste of fuel, the more nearly shall we approximate to the theoretical extent of the economy of the air-engine, an extent far exceeding that to which the economy of the steam engine is restricted;

and the more fully, in short, shall we accomplish that which has hitherto been very imperfectly done *to realize the advantages of the air-engine.*

The fourth section described the improved air-engine of Messrs. James Robert Napier, and W. J. Macquorn Rankine. In this engine the heating surface is increased to any required extent by means of tubes employed in a peculiar manner. The waste of heat by its communication to the air at improper periods of the stroke, is prevented by a sort of plunger, or combination of plungers, called the *heat-screen,* which prevents any access of the air to the heating surface, except when it is in the act of expanding, and so performing work. The engine may be made of the same size with a steam engine of the same power, or smaller, according to the degree of condensation at which the air is employed. The air-receivers of an experimental engine, with their various fittings, were completed some time since, without practical difficulty, notwithstanding the novelty of their construction; but the erection of the engine has been retarded by delay in the execution of the cylinder, fly-wheel, shaft, and other parts, which are similar to those of a steam engine.

Independently of the amount and value of the saving of fuel, which will result from the introduction of the air-engine, it possesses the important and incontestible advantage, that even should an air receiver burst (which is very unlikely) the explosion would not be felt beyond the limits of the engine itself; and hot air does not scald. *Proceed. Brit. Association.*

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*Machine for Washing Coal.**

The great advantage of purifying coals for most manufacturing purposes, and of utilising the inferior portions of coal-seams, is now strongly felt, if we may judge by the number of machines which have been proposed to effect the removal of the impurities. This machine is simple in the extreme. It consists of a large circular cistern cooped in the ordinary way, in which a wooden framework or agitator is made to revolve by means of an upright shaft driven by suitable gearing. The bottom is dished, and in its centre is a hole, to which a sort of cast iron conical pocket is fitted, the lower end of which is closed by a valve opening downwards into a canal with a bottom of wire gauze. Immediately above the bottom three pipes enter at equal distances from one another for the purpose of supplying a constant flow of water. A little above the level of these, at one side, is a rectangular opening provided with a valve, which opens upon another canal with a wire gauze bottom. The cistern is kept about three-quarters full of water; and the small coal, carried up by a chain lift or other mechanism, falls by means of a hopper into the water. The motion of the agitator causes the fragments to describe curves of more or less length, and this allows time for them to arrange themselves according to their specific gravity. The fragments of schist and pyritic coal, being much heavier than pure coal, fall at once on the inclined bottom, and then through a grating pass into the pocket above mentioned, which is emptied from time to time by means of the valve. The fragments of pure coal escape with the water through the rectangular open-

* From the London Artizan, August, 1854.

ing, and fall upon the grating, which has an oscillating motion, which serves to project the coal into a wagon or vehicle, whilst the water escapes through the grating.

Two men would be sufficient to work a cistern of about 40 ins. high and 40 inches in diameter, and capable of washing about 20 metrical tons in the day with a force of one horse. A cistern of about 9 feet 10 ins. in diameter and depth would wash 200 tons in the day, and would require a force of 10 horses to work it. The smaller machine would cost about £80, and the larger about £400.—*Bulletin de la Société Industrielle de Mulhouse*, No. 123, p. 292.

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*Pendulous Reciprocating Steam Engine.**

A novel and cheap steam engine has lately been invented under the above title. It is "an eccentric revolving on its own diameter," in a "cylinder" or steam chamber suspended as a pendulum, the shaft on which the eccentric piston is keyed, being the main or driving shaft, and makes upwards of 100 revolutions per minute in a thirty horse engine. The principle of this engine is similar to the ordinary engine but it works with much less friction; a thirty horse high pressure will work with one pound of steam. "An eccentric revolving on its own diameter" contains the two motions of the ordinary engine, viz., rectilinear and revolving, though so amalgamated as to be hardly distinguishable. It has been received favorably by the Lords of the Admiralty, being especially adapted for screw propulsion, from the small space it occupies and the speed that can be obtained direct. The inventors and patentees, Messrs. Shiptons & Simpson, engineers, Manchester, obtained a medal at the Exhibition of 1851, since which great improvements have been made by them.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, December 21, 1854.

Samuel V. Merrick, President, in the chair.

John F. Frazer, Treasurer.

Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

Letters were read from the Virginia Mechanics' Institute, Richmond, Va.; and the Pottsville Scientific Association, at Pottsville, Penna.

Donations to the Library were received from the Royal Geographical Society, and the Institute of Actuaries, of London; J. L. Dodge, Esq., Rome, New York; the New Orleans Academy of Science, Louisiana; and Prof. John F. Frazer, and Messrs. Chas. E. Smith, and George M. Conarroe, Philadelphia.

Donations to the Cabinets were received from Messrs. Joseph Harrison, Jr., and Richard Griffith, Philadelphia.

The periodicals received in exchange for the Journal of the Institute were laid on the table.

* From the Lond. Civ. Eng. and Arch's. Jour. March, 1854.

The Treasurer read his statement of the receipts and payments for November.

The Board of Managers and Standing Committees reported their minutes.

The Standing Committee on the Cabinet of Minerals and Geological Specimens, submitted for approval a set of rules adopted by them for their government, which was read and laid on the table until next meeting.

Resignations of membership in the Institute (65), were read and accepted.

New candidates for membership in the Institute (157), were proposed, and the candidates (21), proposed at the last meeting, were duly elected.

Nominations were made for Officers, Managers, and Auditors of the Institute for the ensuing year.

Mr. Fairman Rogers exhibited a large drawing of a lathe for turning cast iron pulleys for shafting, arranged by James Nasmyth, Esq., C. E., of Patricroft, England. In this lathe, the slow motion for the mandrel is got by gearing down directly with an endless screw and a worm wheel on the mandrel, the endless screw being driven by a belt from the shafting over head, thus dispensing with the usual number of pulleys for reducing the speed of the shafting. The pulleys to be turned are bored, and keyed upon a mandrel, of which there are a number provided of various sizes, the two centres of these mandrels being bushed with steel in a very ingenious manner. The slide rest is made like an ordinary hand slide rest, but the feed is given by a wheel and a T ratchet worked by a fine chain from a vibrating arm above, which is moved by a chain from an arm moved by a cam on the lathe mandrel; the chain can be hooked to any length, and so attached to the feed ratchet any where about the lathe.

Also, the full and detail drawings of Nasmyth's Steam Pile Driver, for the inspection of the members.

The above lathe is a specimen of some of the highly ingenious and beautiful machinery with which Mr. N's. extensive machine shops are stocked.

Mr. Rogers also described Mr. McLaughlin's plan for attaching the brakes of railroad cars so as to render them self-acting upon the speed of the locomotive being checked. A long wooden bar or rod, so connected with the brakes that its motion backwards or forwards longitudinally will close them, is fastened under each car, and projects beyond the buffers. When the engine is stopped, the inertia of the train causes the cars to approach each other, and the ends of the bars coming together the brakes are applied; as the train comes to rest, the bars are brought back to their normal positions by springs. The arrangement of the bars and links seems to be very simple, and not liable to get easily out of order. It is said to be in successful operation on the Camden and Amboy railroad.

A brake on a similar plan will be found described in the last December number of the *Journal*, from an English Magazine.

Dr. Hare exhibited two forms of apparatus to illustrate the fact that the heat of condensing moisture in the upper regions of the atmosphere causes an upward current at the surface, as supposed in the Espy theory of tornadoes. Dr. Hare also explained his own theory of tornadoes and water spouts, in which they are attributed to convective electricity.

JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

PROMOTION OF THE MECHANIC ARTS.

FEBRUARY, 1855.

CIVIL ENGINEERING.

For the Journal of the Franklin Institute.

On the Defective Manufacture of Railroad Bars. By WM. TRURAN, Esq.

With the introduction of railroads, in the truly national sense of the expression, the attention of numerous scientific and practical men was directed to the deflexion of rail bars under the various pressures to which they were subjected, the object of their inquiries being the discovery of a form which should possess the greatest stiffness, both vertically and laterally, with the smallest consumption of metal.

The fish-bellied rail was, on its invention, considered to possess these properties in a remarkable degree; but from causes which need not here be detailed, the calculations which were formed regarding its stability, were not realized in practice, and it was replaced by others of a parallel form. Wrought rail bars are now rolled of one uniform depth from one end to the other, without reference to their sectional construction. It is to bars of this form, then, that scientific men have directed their attention by testing, in various ways, their capabilities and qualities. The deflexion of rails of different depths and weights when placed on the same bearings under similar loads; the deflexion of a rail at various bearings with the same weight; and the deflexion of the same rail at fixed bearings, but variously loaded, has been ascertained, by direct experiments conducted by competent engineers, who have recorded their observations in scientific journals in the United States and England. The beneficial effects of the publicity given to their inquiries is beginning to be seen, in the increased depth and weight of the rail bars now making over those

manufactured a few years since, and in the reduction of the distances between the bearings (where intermediate supports are adopted in preference to the longitudinal system,) from the dimensions originally fixed upon as the most proper. By thus increasing the depth and weight of the rail, conjointly with a diminution of the distance between its supports, the strength of the rail bar is immensely increased, and the deflexion from a right line on the passage of heavily laden carriages, is exceedingly small on judiciously proportioned roads worked with suitable stock.

Although the proportions of rail bars most conducive to economy in the expenditure of metal and working power, has been ably investigated by scientific men of great attainments, yet, in consequence of the difficulty and expense necessarily attending any extensive experiments on heavy metallic bars, added to the limited acquaintance possessed by such men of the process of manufacturing rail bars, much important information may still be acquired by those possessed of the means and inclination for making further experiments—especially, if their inquiries be directed to the different effects produced on the finished rail bars by departures from the mode of manufacturing usually pursued. The most correct deductions will be obtained where the requisite science is combined with an intimate practical acquaintance with the modes of manufacture adopted. Manufacturers, themselves, would, therefore, appear to be the most eligible parties for conducting such investigations; but, a blind adherence to established rules and procedure, is eminently characteristic of rail manufacturers. Rarely endowed with the desire and abilities for elucidating the causes of the phenomena daily witnessed in their factories, and abundantly occupied with the management of their properties, science has secured little assistance or encouragement from them beyond the adoption of its principal discoveries, when these have resulted in an immediate diminution of the expenses of manufacturing. As a necessary consequence of this incompetence to deal with subjects requiring scientific research, sufficient attention is not paid to the various effects produced on rail bars by causes which, from their simplicity and apparent insignificance, are too often considered as beneath the notice of practical men, but which are in reality of the greatest importance.

The writer has already noticed in previous numbers of this *Journal*, the injurious effects produced on rail bars by the employment of various size bars in the same pile, by which seven-eighths of the bars made are rendered less or more unsound, and has described a simple means whereby metal of a fibrous structure may be readily converted into bars of a crystalline fracture. It now remains only to notice the extraordinary discrepancies observed in the deflexion of rails of the same pattern and quality when placed on the same blocks, loaded with similar weights for similar periods of time, to show the utter inattention exhibited at iron works to the most essential particulars to be attended to in manufacturing malleable iron rail bars.

The attention of the writer was directed to the subject of deflexion, by observing that bars of reduced section frequently deflected less from a straight line than others of a heavier and, undoubtedly stronger section. And what appears equally strange, the deflexion of bars made in the same manner and within a few minutes of each other, differed very considera

bly: while one bar deflected 1 inch, another of precisely the same pattern and make, deflected 1·5 inch under similar circumstances. Still greater irregularities have been noticed in the proving machine.

Extraordinary as this irregularity in the deflexion of similar bars under like circumstances may appear, the quantity of permanent deflexion or 'set,' remaining after the removal of the pressure, differed still more widely in the case of different bars. It was ascertained by numerous experiments, that the 'set' taken by some bars was twelve times that taken by others.

It was at first supposed that this difference arose from some variation or irregularity in the mode of piling, and also in the quality of the metal employed. Alterations were therefore made in the piling, and the results noted, but the irregularity of the deflexion was equally great as before. The quality of the metal was then correctly ascertained and disposed in the most effective manner for offering the greatest resistance to the compressing and tensile forces, but without success. Attention was next directed to the heating and rolling processes, when it was discovered that the deflexion was slightly affected by the mode in which the heating had been conducted. The primary cause, however, remained undiscovered, and further experiments were required to ascertain the cause of this widely spread, though little known, defect in railroad bars.

In the course of the preceding experiments to discover the defect, by altering the arrangement of the piles and the disposition of the various qualities of metal, it was frequently observed that the same rail was more elastic when pressed on one side than when pressed on the other, although of that form known as the parallel double-head rail with the same quantity and a similar quality of metal in each head. On repeating the experiments and recording the results, it was observed that in very few of the bars was the strength to resist compression the same from either side. The variation was very great, and after carefully conducted observations, the same difficulty in arriving at a satisfactory solution of the cause was experienced as in the previous experiments, having for their object the discovery of the cause by which different bars possessed different degrees of elasticity. The quality of the metal and manner of working, were found to affect it, but in a degree too inconsiderable to be considered as the acting cause.

The importance of the subject, and the beneficial results aimed at, rendered the inquiry one of no common interest, and, notwithstanding the non-success which had attended the experiments thus far tried, the subject was prosecuted, but instead of confining the inquiry to the quality of the metal and mode of working, circumstances pointed out the propriety of taking into consideration the form of the bar before passing through the finishing operation, termed 'cold straightening,' and, trifling as it may seem, the longitudinal form of the rail was found to exercise a most important influence on its strength to resist deflexion. Indeed, the great variation in the deflexion of rails when tested under like circumstances, was ultimately discovered to be owing to the form of the rail before cold straightening. If perfectly straight, and the quantity of metal disposed equally, the deflexion on the application of the pressure to each side will be nearly alike ; but if it partakes of a curved profile, the deflexion will

be unequal, and its elasticity also, will be greater when on one side than when on the other. From the little attention which has been paid to this department of the manufacture, the greater number of the rails are less or more curved before undergoing the cold straightening process.

In the majority of rails that are made, the bulk of metal in the head is greater than that in any other part, and, in cooling, this mass of metal retains the heat so much longer than the thinner portions of the bar, that it contracts after the other portions have parted with their caloric, and impart to the upper or wearing side of the bar a concave outline. To counteract this tendency to assume a curved form, the bar is bent over a convex block whilst hot, by which means it becomes curved in an adverse direction; hence the change of form which occurs in cooling tends to produce straightness. The convexity given to the bar when hot, is equal to the concavity which it would assume in cooling from a straight line; theoretically, therefore, it should require no after straightening, but practically, it is otherwise. The bars when stocked on the rail bank are variously curved, some convex, others concave—very few approaching the desired straightness. This irregularity occurs principally from the different temperatures possessed by the bars when being curved; the convex block having been made to suit the most usual temperature of the bars when they arrive at this point of the manufacture, any excess or diminution therefrom will result in a corresponding deviation from a straight line. In the case of parallel double-head rails, the operation of curving is unnecessary, but the unequal rates of expansion and contraction of different descriptions of metal, not unfrequently cause such bars to deviate considerably from a right line.

Of the sufficiency of this agent to cause the irregularity mentioned, there can, on an examination of the subject, be but one opinion. Assuming that the bar before straightening has a concave profile which is to be brought straight by hammering or pressure, it will be evident that the particles of metal on the concave side must be violently distended, and those on the under or convex side will be compressed to produce this result. To understand better the effects of this forced straightening, the generally received opinion that wrought iron is inelastic, must be abandoned, when it will be conceded that the particles of metal forcibly strained, acting in concert with those compressed, have a direct tendency to restore the bar to its original profile. If, then, this bar be laid on supports or continuous bearings, there will be, in addition to the pressure excited by the load, the direct tendency of the metal in the bar to return to its curve to deflect it from a right line.

On the other hand, if the rail bar had been convex on the upper side and concave on the lower, the effect of straightening it would be the lateral compression of the upper fibres conjointly with an elongation of the lower strata of fibres—the reverse, in short, of the above—thus, at one and the same operation, adding to the closeness of the resisting media and bringing the tensile properties of the lower portion of the bar into a state of permanent tension. The properties of the metal having been brought into full play while the bar is in a quiescent state, the deflexion, on the application of the load, is immediately retarded, and the ultimate descent is also from the same cause greatly diminished from what it would other-

wise be. That this view of the matter is correct, we may adduce in its support the well known fact that the application of a weight on a perfectly straight rail which has received no cold straightening, results in an immediate deflexion from a right line proportionable to the load and length between supports, and this deflexion will increase until the resistance offered by the metal to the further compression of the upper and distension of the lower parts of the bar equals the weight applied.

The experiments herein alluded to, were made principally on rails of the double-head pattern weighing about 70 pounds per yard. They were placed on cast iron supports 13 feet 1·5 inches between bearings; at this bearing a weight of 4300 pounds was suspended on the centre of the rail for one minute. With bars straight from the rail bank, the deflexion on the application of this load averaged 1·380 inches. With bars which had a rise or convexity of the upper surface of ·5 inch, which was subsequently removed by cold straightening, the descent was 1·181 inches, but with a rise of 1·3 inches, the descent or deflexion on the application of this weight, was ·986 inch only. These are the average results from more than 400 bars tested in this manner. They exhibited in the most conclusive manner, that increased strength to resist deflexion may be imparted to the rail by attention to its longitudinal form before being cold straightened.

The inability of the bars to resist deflexion when they had a concave profile, was demonstrated by a few experiments on bars which had a concavity of ·5 inch before cold straightening. The application of the load of 4300 pounds, resulted in an immediate deflexion of 1·763 inches, or ·383 of an inch more than with bars which had received no cold straightening. With bars having a concavity of more than ·5 inch before straightening, it was observed that the deflexion was proportionably greater. The deflexion being 1·380 inches with bars which had not been cold straightened, this dimension added to the quantity of concavity taken out by hammering or other straightening, gave the deflexion of such bars very nearly.

The deflexion which remained after the removal of the load of 4300 pounds, varied with the amount of convexity given to the rail. In those which had been brought out from the rail bank straight, the deflexion or permanent set from a straight line occasioned by this weight, was equal to ·102 inch. The bars which had a convexity of ·5 inch before straightening, retained a permanent set of ·057 inch, but those which had been curved to the extent of 1·3 inches before straightening, retained after the removal of the load a permanent set of ·0118 inch only. Rails which had been hammered straight from a concave profile, retained a permanent deflexion much greater than the others. Instances were recorded of such bars retaining a set of ·210 after the removal of the load.

During the experiments it was observed, that curving the rail so that it had a convexity of more than 1·3 inches in 13 feet 1·6 inches was not attended with corresponding advantage. This is the highest curvature that should be attempted in practice with the metal commonly used. If it is exceeded, the permanent strain on the lower fibres of metal produced by the cold straightening appears to weaken the rail. In the course

of some experiments, having a different object in view, it was ascertained that the rails usually manufactured for railroad companies, would not bend cold to a less radius than 20 inches without fracture of the outer rim of metal; and when curved of a greater radius, the effect of the curvature was to diminish the strength of the rail to resist fracture from a weight falling freely on it while supported on cast-iron blocks, in a ratio corresponding nearly to the radius to which it had been curved.

In the course of these experiments, one other fact was discovered, having a material influence on the strength of rail bars, which it may be proper here to record. We have already stated, that the deflexion of a straight bar which had received no hammering, after cooling with a load of 4500 pounds on the centre between supports 13 feet 1·5 inches apart, averaged 1·380 inches, and the permanent set, ·102 inch. A number of the rails thus tested were submitted to a repetition of the test after standing one hour unloaded, when it was ascertained that they descended still further; the additional deflexion averaging ·039 of an inch, but on the removal of the weight the permanent set occasioned by this second test, in addition to that caused by the first, amounted on the average to ·013 inch only. On a number of bars, the test was repeated a third time, after they had stood 12 hours, with still more striking results. The additional deflexion due to the third testing, averaged ·004 inch, and the permanent set ·003 inch. These experiments show the importance of bringing the tensile properties of the metal in action before applying the load, if a minimum deflexion is desired. But their application, by causing a departure from a straight line in the finished rail, is inadmissible in practice. It can be done, however, in the manner we have described, viz. by giving the surface of the rail a convex profile while hot, and afterwards bringing it straight by hammering or pressure when cold.

From inattention to this property of iron rail bars, the rails on the majority of the roads constructed have, from the passage of heavy engines and loaded cars, deflected from a straight line, so as to present a concave profile varying in its depression from a right line from one to five-tenths of an inch.

The facts herein detailed are deserving of attention from engineers generally, now that wrought iron is extensively used in various structures. We may cite an instance of its successful application in the construction of an iron building, where wrought iron wall plates, 22 feet long by 7 inches deep, supported at this distance apart by iron pillars, carried the iron couples and slate roof of a building 33 feet span in the clear. The increased stiffness attained by curving rail bars when hot, induced the application of the principle to these wall plates, which were curved 1·75 inches—the convex side being placed uppermost. On the completion of the structure, the wall plates deflected from their previous form until they became nearly straight. Hence, had they been straight when put up, the deflexion of 1·75 inch from a straight line would have produced a convexity in the under side of like amount, and, consequently, disturbed the whole of the frame-work of the roofing.

*On the Strength of Locomotive Boilers and the Causes which lead to Explosion.**† By William Fairbairn, F.R.S.

(Continued from page 7.)

The statements contained in the earlier part of this paper regarding the strength of the stays of the fire-box would have been incomplete if we had not put those parts of a locomotive boiler, comprised in the flat surfaces or sides of a fire-box, to the test of experiment. This was done with more than ordinary care; and in order to attain conclusive results, two thin boxes, each 22 inches square and 3 inches deep, were constructed; the one corresponding in every respect to the sides of the fire-box, distance of the stays, &c., the same as those which composed the exploded boiler; and the other formed of the same thickness of plates, but different in the mode of staying, which, in place of being in squares of 5 inches asunder, as those contained in the boiler which burst, were inserted in squares of 4 inches asunder. The first contained sixteen squares of 25 inches area, representing the exploded boiler, or old construction; and the other, twenty-five squares of sixteen inches area, representing the new construction.

To the flat boxes thus constructed, the same lever, valve, and weight were attached as used in the previous experiments; and having applied the pumps of a hydraulic press, the following results were obtained:—

Table III.—*Experiment 1st.—To determine the ultimate Strength of the flat surfaces of Locomotive Boilers when divided into squares of 25 inches area.*

No. of Experiment.	Pressure in lbs. per sq. inch.	Swelling of the sides, in inches.	No. of Experiment.	Pressure in lbs. per sq. inch.	Swelling of the sides, in inches.
1[1]	245	+	11	545	·05
2	275	+	12	575	·05
3	305	+	13	605	·06
4	335	+	14	635	·06
5	365	+	15	665	·06
6	395	+	16	695	·07
7	425	+	17	725	·07
8	455	·03	18	755	·07
9	485	·03	19	785	·08
10	515	·04	20	815	—[2]

[1] The box representing a portion of the flat surface of the side of the fire-box of a locomotive boiler was composed of a copper plate, on one side ½-inch thick, and an iron plate on the other ⅜-inch thick, being the same in every respect as the boiler which exploded.

[2] Burst by drawing the head of one of the stays through the copper, which, from its ductility, offered less resistance to pressure in that part where the stay was inserted.

The above experiments are at once conclusive as to the superior strength of the flat surfaces of a locomotive fire-box, as compared with the top, or even the cylindrical part of the boiler; but taking the next ex-

* Extracted, by permission, from the forthcoming Volume of the 'Transactions' of the British Association for the Advancement of Science.

† From the Lond. Civil Eng. and Arch.'s Journ. June, 1854.

periment, where the stays are closer together, or where the areas of the spaces are only 16 instead of 25 square inches, we have an enormous resisting power; a force much greater than anything that can possibly be attained, however good the construction, in any other part of the boiler.

TABLE IV.—*Experiment 2d.—To determine the ultimate Strength of the flat surfaces of Locomotive Boilers when divided into squares of* 16 *inches area.*

No. of Experiment.	Pressure in lbs. per sq. inch.	Swelling of the sides, in inches.	No. of Experiment.	Pressure in lbs. per sq. inch.	Swelling of the sides, in inches.
1[1]	245	+	25	965	·09
2	275	+	26	995[2]	+
3	305	+	27	1025	+
4	335	+	28	1055	+
5	365	+	29	1085	+
6	395	+	30	1115	+
7	425	+	31	1145	+
8	455	+	32	1175	+
9	485	+	33	1205	+
10	515	·04	34	1235	+
11	545	·04	35	1265	+
12	575	·04	36	1295	·09
13	605	·06	37	1325	·09
14	635	·06	38	1355	·10
15	665	·07	39	1385	·11
16	695	·07	40	1415	·11
17	725	·07	41	1445	·12
18	755	·08	42	1475	·13
19	785	·08	43	1595	·14
20	815	·08	44	1535	·16
21	845	·08	45	1565	·22
22	875	·08	46	1595	·34
23	905	·08	47	1625	—[3]
24	935	·08			

[1] The flat box on which these experiments were made, has the same thickness of plates as that experimented upon in the preceding table, viz., one side of copper ½-inch thick, and the other of iron ⅜-inch thick. The only difference between the two is the distance of the stays, the first being in squares of 25 inches area, and the other in squares of 16 inches area.

[2] From 995 to 1295 lbs., the swelling or bulge on the side was inappreciable.

[3] Failed by one of the stays drawing through the iron plate after sustaining the pressure upwards of 1½ minute.

In the above experiments, it will be observed, that the weakest part of the box was not in the copper, but in the iron plates, which gave way by stripping or tearing asunder the threads or screws in part of the iron plate at the end of the stay.

The mathematical theory would lead us to expect that the strength of the plates would be *inversely as the surfaces between the stays;* but a comparison of the results of these experiments shows that the strength decreases in a higher ratio than the increase of space between the stays. Thus, according to the mathematical theory, we should have—

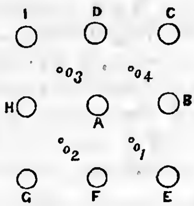
$$\text{Ult. strength 2d plate per sq. in.} = \text{strength 1st plate} \times \tfrac{25}{16} = 815 \times \tfrac{25}{16} = 1273 \text{ lbs.}$$

Now this plate sustained 1625 lbs. per square inch, showing an excess

of about one-fourth above that indicated by the law. This is in excess of the force required to strip the screw of a stay $\frac{1}{1}\frac{1}{6}$-inch in diameter, such as those which formed the support of the flat surfaces in the exploded boiler.

It will be found that a close analogy exists throughout the whole experiments, as respects the strengths of the stays when screwed into the plates, whether of copper or iron; and that the riveting of the ends of the stays adds to their retaining powers an increased strength of nearly 14 per cent. to that which the simple screw affords. The difference between a fire-box stay when only screwed into the plate and when riveted at the ends is therefore in the ratio of 100 : 76, nearly the same as shown by experiment in the Appendix.

Fig. 2.



It is desirable, therefore, that we should ascertain the strain exerted on each stay or bolt of the fire-box. Let A,B,C,D,E,F, represent the ends of the bolt or stays; O_1, O_2, O_3, O_4, the centres of the squares formed by bolts. Suppose a pressure to be applied at each of the points O_1, O_2, O_3, O_4, equal to the whole pressure on each of the squares; then the central bolt A, will sustain one-fourth of the pressure applied at O_1, also one-fourth of the pressure applied at O_2, and so on; so that the whole pressure on A, will be equal to the pressure applied to one of the square surfaces. Hence we have—

$$\text{Strain on the stay of Table III.} = \frac{815 \times 25}{2240} = 9 \text{ tons.}$$

$$\text{Strain on the stay of Table IV.} = \frac{1625 \times 16}{2240} = 11\tfrac{1}{2} \text{ tons nearly.}$$

The stay in the latter case was $\frac{1}{1}\frac{3}{6}$-inch in diameter; hence the strain upon one square of section would be about 13 tons, which is considerably within the limits of rupture of wrought iron under a tensile force.

In the experiments here referred to, it must be borne in mind, that they were made on plates and stays at a temperature not exceeding 50° Fah.; and the question naturally occurs as to what would be the difference of strength under the influence of a greatly increased temperature in the water surrounding the fire-box, and that of the incandescent fuel acting upon the opposite surface of the plates.

This is a question not easily answered, as we have no experimental facts sufficiently accurate to refer to; and the difference of temperature of the furnace on one side, as compared with that of the water on the other, increases the difficulty, and renders any investigation exceedingly unsatisfactory. Judging, however, from practical experience and observation, Mr. Fairbairn is inclined to think that the strengths of the metals are not much deteriorated. His experiments on the effects of temperature on cast iron do not indicate much loss of strength up to a temperature of 600°. Assuming, therefore, that copper and wrought iron plates follow the same law, and taking into account the rapid conducting powers of the former, we may reasonably conclude that the resisting powers of the plates and stays of locomotive boilers are not seriously affected by the increased temperature to which they are subject in a regular

course of working. This part of the subject is, however, entitled to future consideration; and it may be hoped that some of our able and intelligent superintendents will institute further inquiries into a question which involves considerations of some importance to the public, as well as to the advancement of our knowledge in practical science.

APPENDIX.

In order to test with accuracy the tensile power of the different descriptions of stays used in locomotive boilers, and to effect a comparison between those screwed into the plates and those both screwed and riveted, it was deemed expedient to repeat Mr. Ramsbottom's experiments on a larger scale; and by extending the tests to copper stays as well as iron ones, it was considered that no doubt could exist as to the ultimate strength of those simply screwed, the tensile powers of the stays themselves, and the relative difference between those and the finished stays when screwed and riveted on both sides of the fire box. The large lever and requisite apparatus being at hand, the experiments proceeded as follows:

Experiments to determine the Ultimate Strength of Iron and Copper Stays generally used in uniting the flat surfaces of Locomotive Boilers.

EXPERIMENT I.—Iron stay $\frac{3}{4}$-inch diameter, screwed into a copper plate $\frac{3}{8}$-inch thick (as fig. 3.)

No. of Experiment.	Weight in lbs.	No. of Experiment.	Weight in lbs.
1	9,860	4	14,900
2	11,540	5	16,580
3	13,220	6	18,260 [1]

[1] With the last weight, 18,260 lbs.=8·1 tons, the threads in the copper plate were drawn out or stripped after sustaining the weight a few seconds.

EXPERIMENT II.—Iron stay $\frac{3}{4}$-inch diameter, screwed and riveted into a copper plate $\frac{3}{8}$-inch thick (as fig. 4.)

No. of Experiment.	Weight in lbs.	No. of Experiment.	Weight in lbs.
1	9,860	6	18,260
2	11,540	7	19,940
3	13,220	8	21,620
4	14,900	9	23,300
5	16,580	10	24,140 [1]

[1] When the last weight, 24,140 lbs.=10·7 tons, was laid on, the head of the rivet was torn off; and the stay, along with the threads in the copper, was drawn through the plate.

EXPERIMENT III.—Iron stay $\frac{3}{4}$-inch diameter, screwed and riveted into an iron plate $\frac{3}{8}$-inch thick (as fig. 4.)

No. of Experiment.	Weight in lbs.	No. of Experiment.	Weight in lbs.
1	9,860	6	23,300
2	13,220	7	25,980
3	16,580	8	26,660
4	19,140	9	27,940
5	20,780	10	28,760 [1]

[1] With the last weight, 28,760 lbs.=12·5 tons, the stay was torn asunder through the middle, both screw and plate remaining perfect.

Experiment IV.—Copper stay ¾-inch diameter, screwed and riveted into a copper plate ⅜-inch thick (as fig. 4.)

No. of Experiment.	Weight in lbs.	No. of Experiment.	Weight in lbs.
1	9,860	4	14,900 [2]
2	11,540 [1]	5	16,265 [3]
3	13,220		

[1] With 11·540 lbs. the body of the stay was slightly elongated.
[2] Elongation considerably increased with 14,900 lbs.
[3] Broke with 16,265 lbs.=7·2 tons, after sustaining the load upwards of three minutes. The ultimate elongation was 0·56 inch in a length of 3 inches.

Fig. 3.

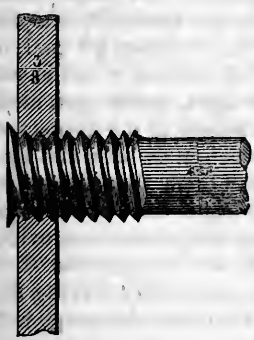
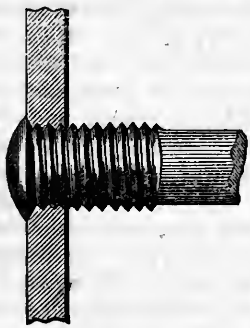


Fig. 4.



It will be observed, on comparing the results obtained from the above experiments, that iron plates and iron stays are considerably stronger than those made of copper. It may not be advisable to have the interior fire-box made of iron, on account of its inferior conducting powers and its probable durability; but so far as regards strength, it is infinitely superior to that of copper, as may be seen by the following:

Summary of Results.

No. of Experiment.	Breaking weight in tons.	Resistance per sq. inch in tons.	Ratio, Exp. III., the iron stay and iron plate taken as 1000.	
III.	12·5	27·7	1000 : 1000	Iron and iron.
I.	8·1	18·8	1000 : 648	Iron and copper screwed only.
II.	10·7	23·6	1000 : 856	Iron and copper screwed and riveted.
IV.	7·2	16·1	1000 : 576	Copper and copper screwed and riveted.

On the above data, it will be found that the iron stay and copper plate (not riveted) have little more than one-half the strength of those where both are of iron; that iron stays screwed and riveted into iron plates are to iron stays screwed and riveted into copper plates as 1000 : 856; and that copper stays screwed and riveted into copper plates of the

same dimensions, have only about one-half the strength of those where both the stays and plates are of iron. These are facts in connexion with the construction of locomotive, marine, and other description of boilers having flat surfaces, which may safely be relied upon, and that more particularly when exposed to severe strain, or the elastic force of high-pressure steam.

On the Means of Avoiding Smoke from Boiler Furnaces. By Mr. W. Woodcock.*

The author commenced by explaining the nature of smoke as existing in furnaces, the cause of its formation, its component gases, and the temperature at which they became inflammable; and then pointed out a method of preventing the evolution of opaque smoke by simple and apparently effective means. It was stated that ordinary pit coal, under the process of destructive distillation, gave off various volatile substances, some of which were gases, such as hydrogen, marsh gas, olefiant gas, carbonic oxide, &c.; these and others existed in the furnace only in a gaseous state, becoming liquid or solid when in the external air; and of such, coal-tar was composed: and amidst them the carbon, in minute subdivision, was held in suspension,—giving to the smoke its sable hue. All these gases were combustible at given temperatures, provided a certain amount of oxygen was present. It was then shown that the air containing this oxygen, if imparted to the gases after leaving the fuel on the bars, must be administered so as not to reduce the temperature of the gases below their flame points.

The formation of smoke, or visible carbon held in suspension, was stated to depend entirely upon the insufficiency of the supply of oxygen in the furnace, as the heat of the furnace would cause the various gases to be given off more rapidly than their combustion could be supported by the quantity of oxygen passing through the fire-bars in the same period of time; this evil being much aggravated by the heat of the air as usually supplied from the ordinary ash-pit, generally ranging from 200° to 300° Fahr., and the air at that heat containing less oxygen, by about one-third, than at the usual atmospheric temperature; and, consequently, the combustion of the fuel to which it was supplied must be one-third less perfect.

The simplest means of preventing the formation of smoke were shown to be by providing for an ample supply of oxygen in a condensed state in the form of cold air, to the fuel on the fire-bars, and by administering such further supply of oxygen to the heated gases as might be necessary for their complete combustion whilst in contact with the boiler; this latter supply being given at such a temperature as would insure the successive ignition of the gases as they were evolved. Thus, by establishing nearly perfect primary combustion, the quantity of smoke evolved was shown to be reduced to a minimum, of which no visible trace ever reached the summit of the chimney.

The apparatus by which this desirable end was attained, was described

* From the Lond. Journ. and Rep. Science, Dec., 1854.

as consisting of two parts, each being the addition of a very simple apparatus to the ordinary boiler furnace. The first of these was a double set of thin iron bars lying horizontally in the direction of their length parallel to each other, immediately beneath the grate in the ash-pit. Each set of bars resembled a venetian blind in its arrangement; the bars being inclined at an angle of 45° to the horizon in the direction of their width. The bars of the two sets were thus inclined in opposite directions, and placed so close together that a vertical straight line could not pass between any adjacent pair of them, yet far enough apart to allow all cinders to fall freely through, and the air to pass freely upwards to the fire. The bars were of the same length as the grate, so as to extend from front to back. It would be perceived that the effect of this arrangement must be to screen the ash-pit completely from the heat radiated directly downwards from the grate, and so that scarcely any would pass through by reflexion. In fact, not a ray of heat could reach the ash-pit from the furnace without suffering four reflexions from rough iron surfaces, which would leave a mere shadow of a ray for further progress. Thus, a large quantity of heat which otherwise would be radiated out of the furnace into the ash-pit, thence reflected and so lost, was saved for the boiler. The ash-pit also was only slightly heated by the cinders which fell through: and this source of heat might be reduced to any extent by frequently removing the rubbish from the pit. Another consequence was, that the air passing from below through the grate, not being heated in the ash-pit, entered the fire cold, and therefore not—as it did from ordinary ash-pits—in a rarefied condition. By its coolness, this air prevented to some extent the burning of the grate-bars; and, by its unrarefied state it produced a more intense and rapid combustion of the fuel after it had passed the bars.

Another part of the contrivance was more especially the smoke-burning apparatus. It consisted of a set of tubes open at both ends, passing through the furnace horizontally from front to back, and terminating within the wall of the front of the bridge, with valves to regulate the access of air into the tubes. The fire-bridge differed importantly from that of an ordinary furnace: it was hollow, and was divided into two parts, the larger of which stood up from below; the other, which was shallower, was in contact with the boiler. Between them all the products of combustion passed from the furnace. The two parts communicated with each other by channels at the sides, and thus formed together an annular chamber. The tubes before mentioned entered the front wall of this chamber, and thus established a communication between its interior and the outer air. The back wall or plate, both of the upper and of the lower part of this chamber or bridge, being perforated with numerous holes, opening from the interior of the bridge to the space beyond it, established a direct communication between the outer air and the throat of the flue. There was a second solid bridge beyond the first, descending from the upper side of the flue; this, by interrupting the direct channel through that part of the passage, retarded the flow of the smoke and gases, and caused their perfect mixture with each other within the space between the bridges.

The result of this arrangement was, that a current of highly-heated

air which passed through the tubes in the furnace, escaped at the bridge through the perforations in the back wall, and, mixing with the gases from the furnace which held the smoke in suspension, converted the smoke into flame.

It was contended that, by the adaptation of this apparatus to marine boilers, the high temperature of the stoke holes and boiler-rooms would be obviated, and that the steam vessels would not be so evident from a distance as they now were by the volumes of smoke they gave out; and by having a telescopic sliding funnel, and substituting, during the period of being in action, a horizontal tube with a small fan-blower, any injury to the main funnel would be effectually prevented.

It appeared that the results of this apparatus had been very satisfactory; that at Messrs. Meux's brewery there was not the slightest appearance of opaque smoke from the chimney; and that the money-saving, resulting not only from the more perfect combustion of the fuel, but from the use of an inferior quality of coal at a lower price, amounted to full twenty per cent.

November 21st, 1854.—The discussion was renewed on Mr. Woodcock's paper, "*On the Means of Avoiding Smoke from Boiler Furnaces;*" when it was shown, that although critically precise experiments for determining the amount of evaporation had not been previously made, there was no doubt of the fact of its being possible to use a lower-priced fuel, and to do the full amount of work with the boiler, without evolving any opaque smoke from the chimney; and thus, whilst complying with the requirements of the legislature, a pecuniary saving could be effected. Recently, however, by experiments on a cylindrical boiler, 17 feet long by 3 feet diameter, it had been shown, that $8\frac{9}{16}$ lbs. of water, injected at 42° Fahr., was evaporated by 1 lb. of Newcastle small coal, when Mr. Woodcock's apparatus was in use. It was found, that with small bituminous coal, a better evaporation was maintained than when Llangennoch coal was used, and without any appearance of smoke. The cast iron bridges of the furnace did not appear to suffer from the effects of the fire,—the passage of the air keeping the metal comparatively cool.

As soon as the valves of the apparatus at Messrs. Meux & Co.'s brewery were closed, there was a dense smoke; but on the instant of opening them, the heated gases combined with the oxygen of the air, and flashed into bright flame. Llangennoch coals had been generally used at Messrs. Meux & Co.'s brewery, not from any economy they offered, as they were not so strong as the Newcastle coals, but for the sake of the neighborhood, as they did not give out opaque smoke: however, with the apparatus described by Mr. Woodcock, small Newcastle slack could be used; and as it could be purchased at fourteen shillings per ton, whilst the Llangennoch coal cost twenty-eight shillings, there must be a money-saving, and the boilers worked quite as efficiently.

As to the general similitude between the principles advocated by Mr. C. Wye Williams and those brought into notice by Mr. Woodcock, almost the only difference appeared to be, that the former insisted on the necessity for the coldness of the air admitted, whilst the latter contended for the advantage of heating the air prior to its mingling with the gases.

On this point, many conflicting opinions were given, and examples quoted. It was, however, allowed, that the arrangement of the venetian blind screens below the grate bars, was novel, and was likely to be beneficial in preventing radiation into the ash pits, and thence into the boiler rooms of steam vessels; and there would not be any inconvenience from not being able to introduce prickers from beneath the bars, as good stokers always cleared the bars from above, by the use of the T head tool; and none but idle or bad stokers allowed the clinkers to accumulate, so as to run between the bars, and require the use of the pricker.

The use of heated air was practically contended for, because, when the air was admitted at a low temperature, there was a certain amount of loss from the chilling effect of the stream or film of air, before it mingled with the gases; whereas this effect was not perceived when the air was admitted at a certain temperature. Under Mr. Williams' system, this had been attempted to be provided against by multiplying the number and diminishing the individual area of the apertures for admitting air; but it was argued that, by extending the number of apertures still more, and previously raising the temperature of the entering air behind the bridge, the object would be more certainly attained. The system of supplying air at a very elevated temperature under gas retorts, had been very advantageously employed for many years, in conjunction with the hollow bridge originally introduced by Mr. Farey, the father of the late Mr. John Farey. (M. Inst. C. E.) In corroboration of these views, it was stated, that on board one of the "Citizen" steam-boats on the Thames, by a free admission of air, only through a series of parallel wire-gauze screens in the fire-door, so as to distribute it in minute jets, the exhibition of opaque smoke had been prevented,—whilst a saving of fuel was effected, without any loss of speed, or any extra labor to the stoker. A hollow bridge was also used; and a blast-pipe being extended from the base of the funnel, and opening into the bridge, further beneficial effect had been produced.

A model was exhibited of a hollow cast iron bridge-plate, with a series of vertical ribs, so arranged as to form tubes, leading up from the ash-pit to the apex of the bridge; where the air mingled with the heated gases, and passed away in flame. The currents of air up these bridge tubes preserved the iron from destruction, by carrying off the caloric, and it became heated in its upward course.

The introduction of cold air was advocated, on the ground that a mass of air, once broken up into films, or minute jets, would not again unite, but that each particle would pursue its independent course, until it combined with the heated gases. Therefore, the system of admission by the perforated fire-door, so as to pass over the incandescent fuel, had been so strongly advocated.

It was urged, that mechanical or other means should be adopted for regulating the proportion of oxygen, according to the state of incandescence of the fuel on the bars. This, it was contended, was virtually accomplished through the side tubes of Mr. Woodcock's apparatus; as it had been shown, that the velocity of the passage of air through the tubes, was exactly in proportion with the demand for oxygen by the fuel. That the air was really heated in its passage has been shown by insert-

ing a thermometer, protected from radiated heat, into a flue in connexion with the hollow bridge.

The question of the applicability of most of the systems of preventing the exhibition of opaque smoke, was shown to depend, to a great extent, on the area of the fire-grate and the size of the boiler; for if both were restricted, so as to demand an excessively rapid draft, there could not be a sufficient mingling of the gases to insure perfect combustion.

Proceed. Inst. of Civ. Engin.

For the Journal of the Franklin Institute.

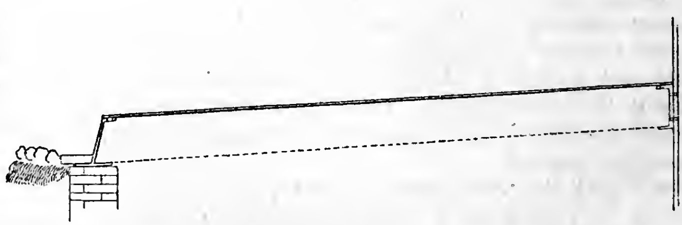
Notice of a new Cast Iron Foot Pavement. By Fairman Rogers, Civ. Eng.

There is now in the course of construction, at the new iron building of Frederick Brown, Esq., Fifth and Chestnut Streets, a new cast iron foot pavement, designed by Mr. B. Severson, Superintendent of J. A. Gendell's Architectural Iron Works, in West Philadelphia.

A small pavement of iron was put down by the same firm a few months ago, at No 58 Chestnut Street. But in the specimen now under consideration, the principle has been carried out to a much greater extent, and the work is of considerable magnitude.

The pavement is made of cast iron plates, 12 feet long, 3 feet 4 inches wide, and $\frac{5}{8}$-inch thick; 12 feet being the width of the pavement from the building to the curb. These plates are roughened on the surface by grooves $1\frac{1}{4}$ inch apart, crossing each other at an oblique angle, so as to divide the surface into diamonds.

A cast iron $\frac{1}{2}$-inch plate, with its two edges turned at a right angle, so as to make flanges at the top and bottom, forming a girder 11 inches deep, is bolted to the columns of the building, making a support on which the inner ends of the plates rest. The curb is of cast iron, $\frac{1}{2}$-inch thick, 11 inches deep, having a flange on *each* side, at the *bottom*, and on the *inside* only at the top; it is made to slope slightly outwards from the top to the bottom.



Scale ¼ inch to the Foot.

This curb rests upon a brick wall, forming the outside wall of the cellar, a good cement being interposed to make a water-tight joint; the pieces of curb have butt joints secured by a cast plate behind, riveted securely to both pieces, cement being interposed. From the building gir-

der to the curb, and resting on the lower flange of each, stretch girders or joists, 12 feet long and 11 inches deep, 3 feet 4 inches apart, on which the pavement plates are laid and securely fastened by bolts or rivets, with counter sunk heads, going through the flanges of the girder, the joists, and the curb.

All the joints are carefully cemented so as to be water-tight; the transverse girders or joists are of ½-inch cast iron, strengthened on the bottom flange by wrought iron flat bars, bolted to the cast iron only at the two ends, and slightly expanded by heating when it is put on, so as to bring the lower part of the girder into a state of compression.

The brick or stone of the gutter, is to be laid upon the outer flange of the curb.

Some of the plates have a circular hole left in them, about 18 inches in diameter, for the reception of the ordinary gratings, for ventilation or access, or of glass *lights*. The glass is cast into its cast iron circular frame, thus forming a strong water-proof joint, the ring being heated before casting the glass in it.

The cost of this pavement, when iron is $35 per ton, is $1·75 per square foot of surface; this includes curb and laying. If the plates are more than 12 feet long, the cost is somewhat increased per square foot, from the greater trouble in casting.

The pavement on Fifth Street is 90 feet long, and that on Chestnut will extend the whole front of the building, a fine airy cellar being left under it, which being partially warmed in winter by the heaters for the building, will melt the snow falling upon the pavement.

The small pavement mentioned above, has been laid down for several months, and appears to answer its purpose very well.

This is the first iron pavement of any size yet laid in Philadelphia, and it seems to promise very great efficiency and convenience; the great ease of removal, in case of repairs, or for any purpose, is certainly a great recommendation.

For the Journal of the Franklin Institute.

On Caustic Lime in Blast Furnaces. By William Truran, Esq.

Caustic lime is now partially employed at several works in Wales and other iron-making districts in Europe, as a substitute for the raw limestone commonly used as a flux in blast furnaces. Although the advantages which are found to attend its application have not fully realized the sanguine expectations of furnace proprietors, they have sufficed to show, that its application is attended with some important results to the metal produced from the blast furnace.

The motives which induced iron masters to try the effects of burnt lime as a flux, appear to have been a desire to augment the production of metal from the blast furnace, conjointly with a diminution of the expenses attendant on the smelting operation. This, it was confidently anticipated, would follow on the substitution of lime, for the carbonate of lime hitherto used. Calculations based on the composition of the gases at different altitudes in the furnace, pointed out the carbonate

of lime as exercising a prejudical effect on the working of the furnace. It was believed that the absorption of caloric by the carbonic acid of the limestone in its passage from the solid to the gaseous state in the blast furnace, would no longer take place, and that the reduction in the furnace fuel would more than compensate for that used in the lime kiln.

It was also believed, that by calcining the limestone previous to its introduction into the blast furnace, the cooling influence which is occasioned in the upper regions of the furnace by its introduction in the raw state would be avoided, and as this increase of temperature over that usually obtained would be equivalent to an increase in the altitude of the furnace, a corresponding augmentation of the usual weekly make of the furnace would result from the altered mode of filling the lime.

Theoretically, a considerable saving is effected by the use of caustic lime, but practically, there is little or none. At works where limestone is filled into the furnace without having been broken into suitable lumps, the reduction in the consumption of the limestone and fuel by the use of caustic lime may be considerable, but where it has been usual to break the limestone into pieces, not weighing more than a few ounces, the diminution is almost inappreciable. Large masses of limestone require a correspondingly longer time for their complete calcination, and while this is being effected, they descend into the furnace along with the ore and fuel, until they have absorbed from the latter the caloric necessary for their complete decomposition. The depth at which this is effected, will depend on the size of the stones used. The larger these are when filled, the deeper will they descend into the furnace before complete decomposition. In those furnaces which are supplied with finely broken limestone, the lumps, from their small bulk, quickly absorb the requisite caloric, and are afterwards in their further descent distributed through the burning materials. The caloric which they absorb during their conversion, is collectively the same as that absorbed by the coarsely broken limestone, but with this difference, that it is absorbed in the upper regions of the furnace; where, if the furnace has been fed with raw bituminous coal, as fuel, the heat is at all times sufficient for the purpose, and can be spared without sensibly impairing the efficiency of the furnace. The calcination or decomposition of the limestone is effected by a certain determinate quantity of fuel, and this will be the same, whether the operation be conducted in the mouth of the blast furnace, or in an independent furnace, so long as it be accomplished before the materials in the furnace have reached the region of the boshes.

At Merthyr Tydfil, the first experimental application of caustic lime was made in a blast furnace, 50 feet high, and 18 feet in its largest diameter. The charge before alteration averaged about 18 cwts. of calcined clay ironstone, 18 cwts. of forge cinders, and 9·5 cwts. of coarsely broken limestone to the ton of coal consumed. With this burden, the make for a period of six months preceding the experiment, averaged 108 tons of forge pig iron weekly. The burden was altered to 18 cwts. of calcined clay ironstone, 18 cwts. of forge cinders, and 6 cwts. of burnt lime to each ton of coal, when the weekly make for the first three months of the experiment averaged 114 tons.

From this experiment it would appear that the application of burnt

instead of raw limestone, was attended with an augmentation of the weekly make of iron equal to 5 per cent. on the make for the preceding six months. On going further back, however, it was found that the average weekly make of the furnace for the preceding three years, was 116 tons. It is, therefore, questionable if the augmentation was solely the effect of the calcination of the limestone.

But, although the augmentation in the make may have resulted from other causes than the use of burnt lime, there appears no reason for doubting its connexion with an improvement observed in the quality of the iron produced. This was decidedly superior to the iron previously made, where softness and ductility were required. Its conversion, however, into refined metal, required more than the usual blowing, and its refractory disposition was still further manifested in the puddling forge, where its conversion into puddled iron was attended with some difficulty.

The consumption of fuel in the blast furnace with the limestone flux, amounted to 38 cwts. on the ton of pig metal produced; with burnt lime it was 36·5 cwts. to the ton, showing a difference of about 4 per cent. in favor of the burnt lime. But, owing to the extra blowing in the refinery and the difficulties encountered in the puddling forge, the additional fuel consumed in these operations, amounting to 3·5 cwts. on the ton of puddled iron, leaves a balance of 2 cwts. in favor of the limestone flux.

In consequence of the curious and very important experiments on Phonic Signals recorded by Mr. Cresson in the Number for December, 1854, we take from the pages of the *London Illustrated News*, 1844, the following description of a very neat, compact, and, we do not doubt, efficient instrument for producing sounds, when a steam whistle cannot be used. EDITOR.

The Telephone, a Telegraphic Alarm.

Amongst the many valuable inventions recently laid before the Lords of the Admiralty, that of the "Telephone, or Marine Alarm and Signal Trumpet," by Captain J. N. Taylor, R. N., is, perhaps, one of the most important; its objects being to convey sound signals to vessels at sea, or in harbor; to transmit orders to and from forts and ships; to prevent collisions at sea, or on railroads; to transmit orders on the field of battle, from position to position, as an auxiliary to the duties of the aide-de-camp, or orderly, who frequently rides with important despatches in the face of an enemy in great haste and imminent risk; to inform engine stations in case of fire; for alarms in dock-yards, &c.; and as a means of communication between the palaces and halls of the nobility and gentry, &c.

The principle of the Telephone is one of musical accord, composed of four alternate notes, given out separately, played like those of the cornet, and prolonged whilst the finger remains on the note. The instrument is formed of a chamber, into which air is compressed through three or more alternate pumps, which are moved by a corresponding number of cranks, set in motion by a winch; and of a set of piston keys, with valved apertures, giving free egress to the compressed air, which, in its passage, acts upon a series of metallic springs, and produces the required sounds through four pipes or trumpets.

The Indicator.—The Indicator, or Signal Tell-Tale, to be placed on the Telephone Drum, to denote the signals made, is composed of 16 holes, in four parallel lines, and numbered at the top 1, 2, 3, 4. The first number made is to be indicated by a peg, placed under the required figure, in the first horizontal column, colored red; the second number in the white; the third in the blue; and the fourth in the yellow line, observing that only one peg is to be placed in the same horizontal row of holes. The Telephone gamut notes are arranged for numbers either by the public or private key. The alternate notes of the gamut C, E, G, C, being denoted by 1, 2, 3, 4.

The Telephone Gamut.—The Telephone, No. 1, will convey signals four or five miles; and as a fleet sailing in three columns will not extend over more than three miles, it will be sufficient for the guidance of the whole fleet, in foggy weather, by night or day. For fixed stations, light-vessels, light-houses, preventive ports, &c., it is made the size of a large drum, with trumpet in accordance, and will convey signals in foggy weather six or eight miles; or by unscrewing the trumpet, and applying a parabolic phonic reflector to it, the sound will be conveyed to a much greater distance.

Ships or steamers passing each other, by giving the signals for "helm to port," &c., &c., would prevent those dreadful collisions and loss of life which frequently occur, either from indecision, the thickness of the fog, or other causes.

As an alarm-instrument, to be used on light-vessels, light-houses, dangerous headlands, &c., the Telephone is most important, as it will be the means of preventing the great sacrifice of life and property, which so frequently takes place in foggy weather, from the lights being invisible. Vessels would also be directed by it to the pier or harbor, and the height of the tide for entering conveyed to those in the offing. On railroads, too, it is of great importance, as an instant signal for stopping the train, increasing the speed, or of the approach of another engine, may be given from the guard to the engineer.

Another advantage of the above instrument is, that it can be employed with a secret key, so that two persons in correspondence will understand the communication, while it remains unintelligible to others.

AMERICAN PATENTS.

List of American Patents which issued from November 14, to December 12, 1854, (inclusive,) with Exemplifications.

NOVEMBER 14.

38. For an *Improvement in Machinery for Carving Stone;* Edwin Allen, South Windham, Connecticut.

Claim.—"I claim the employment of two pantographs, combined with a tracer and cutting tool, to wit: the pantographs being arranged at right angles to each other, and having their main pivots connected or arranged in such a way as to form an universal joint, and the tool and tracer being suspended from or attached to the pantograph, and passing through sockets in the legs of the pantograph, whereby the tracer and tool are allowed an universal movement."

39. For an *Improvement in Smut Machines;* Levi B. Ball, Putnam, Ohio.

Claim.—"I claim the employment of wood and iron slats, placed alternately, or of any other hard and soft substances, arranged in an equivalent manner, and producing a similar effect."

40. For an *Improvement in Cultivators;* William Bancroft, Whiteford, Ohio.

Claim.—"I claim the method of making the knife adjustable upon the frame, by means of a standard and hinged standards."

41. For an *Improvement in Side Valves for the Exhaust Steam;* Henry Bates, New London, Connecticut.

Claim.—"I claim the employment, in combination with the usual slide valve, of a supplemental exhaust slide valve, to be operated by a separate mechanism, to work over a separate series of ports, which are similarly arranged to and communicate with the same passages as the usual ports, for the purpose of giving a free exhaust, till the termination of the stroke of the piston, and for enlarging the area of passage for the exhaust."

42. For an *Improvement in Double Cylinder Boilers for Hot Water Apparatus;* Wm. Beebe, City of New York.

Claim.—"I claim the combination of two boilers, one within the other, and two reservoirs, one above the other, arranged, with one set of connexions, with a kitchen range, so that the upper part of a house may be supplied with hot water, by means of the upper reservoir, which will derive its supply of cold water either from the roof or from a force pump, while the lower part of the house will be supplied by means of the lower reservoir, which will derive its supply from the public water works."

43. For an *Improvement in Furnaces for Making Iron Direct from the Ore;* Martin Bell, Sabbath Rest, and Edward B. Isett, Spring Forge, Tyrone City, Penna.

Claim.—"We claim the series of inclined close deoxydizing tubes or vessels, built of common fire-bricks, and arranged so as to be parallel or nearly so with each other, and inclined at an angle of about fifty degrees from the horizon, so as to lie or rest their whole length securely upon a substantial inclined base, and also so as to be exposed only on the two opposite outer sides of each tube, to the action of the escaping heat from the furnace as it passes along through the intermediate flues, the same being combined with the main flue through the opening, and with the interior of the furnace, each ore tube having an adjustable cut-off or sliding gate at its lower end, and also combined with a separate horizontal way, as described, leading directly into and connecting the said tubes with the bottom of the reverberatory furnace."

44. For an *Improvement in Lamp Caps;* William Bell, Boston, Massachusetts.

Claim.—"I claim the perforation in the lamp cap, in combination with the short chamber of perforated tin, wire-gauze, or other analogous contrivance, by which means the lamp may be filled without removing the cap, and the spirit within the lamp may be protected from igniting, when the lamp is filled, without the use of the double cylinder of wire-gauze or perforated sheet metal, as heretofore employed."

45. For an *Improvement in Cultivators;* Job Brown, Lawn Ridge, Illinois.

Claim.—"I claim the combination of the angular-shaped frame (having the two pieces united at their forward ends into a tongue,) with the long standards and short standards."

46. For an *Improved Device for Adjusting Mill Saws;* T. M. Chapman, Oldtown, Me.

Claim.—"I claim the stocks secured to the upper and lower cross-pieces of the gate or sash, the stocks having a belt or stop at each end."

47. For a *Multigardo Iron Fence;* Matthias P. Coons, Brooklyn, New York.

Claim.—"I claim the combination of the devices, the form of mortise in picket, and the collar and sheave."

48. For an *Improved Mode of Adjusting Vessels upon the Keel Blocks of Dry, Sectional, or Railway Docks;* Horace J. Crandall, East Boston, Massachusetts.

Claim.—"I claim the manner in which the materials, that is to say, the hollow tube, screw, pawl ratchet slide, and bearer, are arranged, for the purpose of holding the keel in the required place."

49. For an *Improvement in Looms for Weaving Figured Fabrics;* George Crompton, Worcester, Massachusetts.

Claim.—"I claim arranging two or more patterns upon a single chain, so that by bringing the rod of the chain into operation in a certain order, one pattern is produced, and by operating them in different order, another pattern is produced. 2d, Placing two or more patterns upon the rods of a pattern chain, side by side, and operating them in succession, by vibrating the chain laterally. 3d, Pivoting the lifting and depressing rods at one end, the other end being made adjustable.

50. For an *Improvement in Sewing Machines;* Daniel Harris, Assignor to John P. Bowker, Boston, Massachusetts.

Claim.—"I claim the so arranging the bent arm, that by its movement it shall perform the triple operation of slacking up the thread as the needle is about penetrating the cloth, and admit of the necessary pause whilst the shuttle passes through the loop, and then tighten up the stitch in advance of the upward motion of the needle bar, and draw from the spool the requisite amount of thread for the next stitch."

51. For an *Improvement in Ploughs;* Jonathan Hibbs, Tullytown, Pennsylvania.

Claim.—"I claim combining with a plough the revolving weed-clearing rollers, armed with spikes, said rollers being operated automatically by a wheel attached to the back part of the plough."

52. For an *Improved Paging Machine;* George Hodgkinson, Cincinnati, Ohio.

Claim.—"I claim, 1st, The construction and combination of the pair of taking-up wheels, weighted double acting tension cord, and type bearer, in combination with the square shaft and trigger, and actuating piston, or equivalent devices, for the proper tension and delivery of the type bearer, during the alternate advancement and impression of the type. 2d, The series of type blocks, consisting, each in succession, of the consecutive odd number, coupled with the even number three units higher in the scale, in combination with an extended platen, and its accessories, or equivalent devices, so as to act at each stroke upon the further pages of two consecutive leaves of an unfolded or open book. 3d, The mode of clamping the type blocks to the band by means of a sheet metal shaft enclosing the rear, side, and edges of the type holders."

53. For an *Improvement in the Method of Engaging and Disengaging Self-Acting Car Brakes;* George T. Leach, Boston, Massachusetts.

Claim.—"I claim the combination of the two jointed pawl levers, the socket shaft and its lever workers, and the two racks, as arranged and applied to the bunter bar and the brake."

54. For an *Improvement in Breech Loading Fire Arms;* F. Maton, City of N. York.

Claim.—"I claim the combination of a sliding breech piece, having a semi-spherical socket, and a partially rotating motion whilst closing on the end of the barrel, with a fixed barrel having a corresponding semi-spherical end, the two forming a cap and ball joint, whereby the powder is brought nearer to the point at which the cap is exploded, a more certain ignition attained, and the joint between the breech and the barrel more effectually closed. Also, the employment, for the front sight of a fire arm, of a needle wire, or its equivalent, having a bulge or enlargement at or near its middle, which is in a horizontal position when the arm is leveled for firing."

55. For an *Improvement in Omnibus Registers;* Wm. Morris, Philadelphia, Penna.

Claim.—"I claim forming a notch near the end of the bell hammer bar, annexed to the toothed bar, so as to cause the same to act as a double pawl or stop on the teeth of said wheel, and prevent a recoil of the same, when the spring bolt and cog have not been drawn sufficiently high to strike the bell and record a fare, and the consequent striking of the bell by the pawl, and of the bar being allowed to move quickly upward upon said recoil."

56. For an *Improvement in Railroad Car Coupling;* Joseph Miller, Orleans, N. York.

Claim.—"I claim the combination of the horizontal acting hook with the vertically moving box."

57. For an *Improvement in Grain Winnowers;* Wm. Moore, Belleville, Ohio.

Claim.—"I claim the arrangement of riddles around a perpendicular fan, so that

grain can pass over each, and be acted upon at any desired point, by wind from said fan."

58. For a *Tape Worm Trap;* Alpheus Myers, M. D., Logansport, Indiana.

Claim.—"I claim a trap for the removal of tape worms from the stomach and intestines, which consists of a trap which is baited, attached to a string and swallowed by the patient after a fast of suitable duration to make the worm hungry. The worm seizes the bait, and its head is caught in the trap, which is then withdrawn from the patient's stomach by the string which has been left hanging from the mouth, dragging after it the whole length of the worm."

59. For *Tape Worm Operation;* Alpheus Myers, M. D., Logansport, Indiana.

Claim.—"I claim the process of removing tape or other worms from the stomach or intestines, by means of a trap, which is baited and swallowed by the patient, and is caused to capture them by the seizure of the bait."

60. For an *Improved Mode of Guiding and Controlling Logs in Saw Mills without a Carriage;* C. B. Normand, Havre, France; patented in England, Oct. 27, 1852; patented in France, Nov. 5, 1852.

Claim.—"I claim the employment of a longitudinal bar above the log, the lower edge of which bar is made sharp or angular, to indent the prominent part or parts of the log, and the said bar being parallel with the line of the intended cut, and movable vertically to suit logs of various sizes. Also, in combination with the bar for controlling and guiding the upper edge of the log, the employment of a like bar on which the log rests and moves."

61. For an *Improved Method of Hanging Saws for Mills;* C. B. Normand, Havre, France.

Claim.—"I claim connecting the saw gate, in which the saws are strained, with the outer ends of two vibrating beams, one at each end, and giving to the saw or saws. Also, composing the ways for the carriage of a series of cylindrical rollers, which can be shifted to variable heights, so that the upper part of their peripheries can be set to coincide with a flat plane, or arcs of circles of large radius, in combination with the flexible carriage, which can be bent to the shape of the intended cut, as determined by the set of rollers composing the ways."

62. For an *Improved Method of Controlling the Log for Curved and Bevel Sawing;* C. B. Normand, Havre, France; patented in England, Oct. 27, 1852; patented in France, November 5, 1852.

Claim.—"I claim the mode of operation for directing the log or timber to the saw or saws, in curvilinear sawing, by means of rollers, or their equivalents, whose axes can be shifted at pleasure to determine and vary the line of motion of the log or timber to the saw or saws, without the necessity of turning or moving the saw or saws laterally. Also, mounting the rollers, which support the log or timber to be sawed, in a sawing or vibrating frame, or the equivalent therefor, so that the plane tangent to the upper edges of the rollers can be placed at any desired angle with the plane of motion of the saw, and there retained or gradually shifted in either direction during the sawing operation, whereby the log or timber can be sawed to any fixed and determined level, or to any level varying in any desired degree."

63. For an *Improvement in India Rubber Overshoes;* J. A. Pease, City of N. York.

Claim.—"I claim making india rubber or gum shoes with the inner surfaces rubbed, corrugated, or otherwise made uneven, for the purpose of allowing a circulation of air between it and the boot or shoe over which it is worn."

64. For an *Improved Excavator and Ditching Plough;* Chas. A. Robbins, Iowa City, Iowa.

Claim.—"I claim the employment of the vertical reciprocating cutter arranged for the purpose of cutting the earth into sods or pieces, for the purpose of rendering the earth easy of removal, either by hand or by endless aprons."

65. For an *Improved Excavating Machine;* George D. Stillson, Rochester, N. Y.

Claim.—"I claim, 1st, The controlling of the cutting edge of the excavator, so as to keep it always at or about the same relative position in regard to the earth to be removed,

and yet admit of being raised or lowered to ease said cutting edge when too powerfully resisted, and thus materially aid the scraper in entering and passing through the earth to be removed. Also, the so hanging of the scraper to the frame which supports it, by means of pivoted radial arms or braces, so that said scraper, and the earth thereon, may, by the turning of a hand wheel, or other equivalent device, be first raised up horizontally, or nearly so, a sufficient distance to admit of its being drawn away, and then by continuing to turn said hand wheel, or other raising power, to gradually tilt and dump the scraper. Also, the hanging of the scraper to the frame or truck, by means of rigid arms, so as to employ the entire weight of the carriage and load upon it, in holding the scraper to its work. Also, the use of a breaker, substantially such as described, placed at or near the front of the scraper, for the purpose of loosening up the earth, and facilitating its progress to the rear of the scraper, and to prevent packing or clogging in the front of the scraper."

66. For a *Shingle Machine;* William Stoddard, Lowell, Massachusetts.

Claim.—"I claim, 1st, The riving knife, in combination with the sliding cap. 2d, The spring stop. 3d, The jaws, or their mechanical equivalents."

67. For an *Improvement in Grain and Grass Harvesters;* J. Swartz, Buffalo, N. Y.

Claim.—"I claim the application to the driving or vibrating of the cutter bar of the crank, pitman toggle levers, hinged lever, and rod, for the purpose of giving four reciprocating motions to the cutter bar for every revolution of the crank shaft. Also, so hanging the cutter and guard tooth bar to the machine, by means of the hinged pieces, as that it may rise and fall in parallel lines, whether used for cutting grain or grass."

68. For an *Improvement in Machinery for Stretching and Drying Cloth;* Benjamin J. Tayman, Philadelphia, Pennsylvania.

Claim.—"I claim, 1st, The means for stretching the cloth while wet, and carrying the same parallel while being dried, consisting of the endless belts of tenter hooks traveling on adjustable guides or ways to accommodate different widths of cloth, which ways are parallel to each other, except at the ends where they converge, to allow the cloth to be hooked on, and stretch the same as it is moved forward. 2d, The application of sponge and fan brushes, in combination with the drying cylinder, to hasten the process of drying the cloth."

69. For a *Saw Gauge;* Orson Westgate, Riceville, Pennsylvania.

Claim.—"I claim the construction of the bed piece with the cog racks, in connexion with the cog wheels, and the brakes pressed upon the said cog wheels by means of the spring."

70. For an *Improved Method of Constructing Printing Blocks;* Leon Jarosson, Jersey City, New Jersey.

Claim.—"1st, Cutting the several parts of the design, or the design and ground, the one out of the other, from a plate or sheet of prepared felt, wood, or other suitable substance, of the thickness of the required relief, and then securing the parts to the surface of blocks by means of cement, glue, or other suitable means, by means of which I am enabled greatly to reduce the cost of producing the printing blocks, for by the one act of cutting I produce two printing surfaces to print with different colors, and in that proportion whatever may be the number of colors of the intended design, and by which, also, I insure the exact fit of the several blocks for printing the several colors."

71. For an *Improvement in Casting Type;* George Bruce, City of New York.

Claim.—"I claim the application of an artificial blast to cool the type mould, or prevent it from overheating in casting, by which printing types can be cast much more rapidly than ever before."

72. For an *Improvement in Rollers for Pattern Chains for Looms;* Geo. Crompton and M. A. Furbush, Worcester, Massachusetts.

Claim.—"We claim a wrought iron tube, made use of for the bearing of the roller, the body of the roller being secured thereto by casting, in the manner set forth, whereby the rollers, when strung upon the chains, are caused to fall into the exact position required to operate the crooked jacks, without the necessity of gearing and turning down the roller, as has heretofore been done."

73. For an *Improved Arrangement in Lever and Catch for Tow Lines of Canal Boats;* J. W. Cadwell, Rochester, New York.

Claim.—"I claim my arrangement of the frame, the tumbler, and the lever, with the ring and spring."

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74. For an *Improved Arrangement of Means for Lubricating the Cylinders of Steam Engines;* John Absterdam, Boston, Massachusetts.

Claim.—"I claim placing the lubricating reservoir remote from the boiler, and interposing between the oil and the boiler, water, air, or other substances which will communicate the pressure from the boiler to the oil, and thus keep the oil from being heated, and yet feeding it to the surface to be lubricated by the pressure from the boiler."

75. For an *Improvement in Hand Brick Moulds;* Clark Alvord, Syracuse, New York.

Claim.—"I claim the application of the discharging piston to the hand mould."

76. For a *Machine for Papering Walls;* Henry F. Baker, Centreville, Indiana.

Claim.—"I claim the manner in which I arrange and combine the cylinders, rollers, and side bars, for the purpose of pressing the paper to the uneven surfaces of the wall, and at the same time press all the air from between the paper and the wall, thereby causing the paper to be laid on smooth, nicely, and evenly, without hand labor."

77. For an *Improvement in Sauce Pans;* Henry F. David, Ipava, Illinois.

Claim.—"I claim my improved manner of opening and closing the cover of a sauce pan or stew pan, and of retaining the same in an open position, viz: by means of the combination of said cover with the rod which passes through the hollow handle of the pan, and is supplied with a spring catch."

78. For *Improvements in Machines for Closing Sheet Metal Boxes;* Chas. G. Everitt, Brooklyn, New York.

Claim.—"I claim, 1st, The arrangement of the driving shaft and upper roller shaft with the adjustable sliding boxes, springs, and treadle, in relation to the lower shaft and frame of the machine, for the ready adjustment and adaptation of other roller heads, and for the putting in and taking out of the sheet metal articles being made. 2d, I claim the arrangement of the adjustable spring frame, with its adjustable friction rollers, and in relation to the roller heads, for the purpose of guiding and sustaining the sheet metal pieces of various shapes and of different widths."

79. For an *Improvement in Valve Gear for Locomotive Engines;* James Freeland, Alleghany, Pennsylvania.

Claim.—"I claim the employment, for the purpose of transmitting motion from the eccentric, or its equivalent, to the slide valve of a rock shaft carrying the eccentric arm which is connected with the valve arm on the usual valve shaft, by means of a connecting lever, an arc formed slat, a rocker, and links, all arranged to give the valve the whole, or the greater part of its movement, during a comparatively small portion of the revolution of the eccentric, or its equivalent."

80. For an *Improvement in Cleaning Cards of Carding Engines;* Samuel Greene, Woonsocket, Rhode Island.

Claim.—"I claim the application of the clearer cylinder and wiper, by which the impurities of the cotton are taken out and formed into a bat."

81. For a *Shingle Machine;* Adoniram Kendall, Cleveland, Ohio.

Claim.—"I claim, 1st, The hopper, slide catch, and slide rests, with the attachment of the spiral springs, and elliptic springs; this combination I claim separately and combined with the driver. 2d, The combination of the sliding key, strap, cross-piece, and spring, for the purpose of holding the shingle while it is being squared by the fingers. 3d, The levers, tumbler, fingers, slide, and spring, operating by means of the grooves and cams, for the purpose of squaring the shingle by the fingers, so that the edges will be jointed square with the butt. 4th, The circular grooved cams, in combination with the levers, connecting rod, spring, right angled levers, and adjustable knife blocks, I claim either separately, or in combination with the guides and levers. 5th, I claim, also, the combination of the reciprocating carriage with the driver."

82. For an *Improvement in Kettles for Calcining Plaster of Paris;* Jerome B. King, City of New York.

Claim.—"I claim the method of fitting a conical or arched bottom to kettles for calcining plaster, so that the same shall be allowed to slide on its bearings as it expands and contracts."

83. For an *Improvement in Seed Planters;* George W. Lee, Ercildown, Penna.

Claim.—"I claim the scores, or their equivalents, at the extremities of the holes in the disks, in combination with the gradual narrowing of the holes towards their extremities, so as to save the grain from being cut between the ends of the hole, *c*, and the edges of the hole, *b*. I claim the shape or form of the end of the hole in the disk."

84. For an *Improvement in Packing Slide Valves in Steam Engines;* Dan. B. Martin, Washington, New Jersey.

Claim.—"I claim the mode of packing balanced slide valves, the same consisting in the attachment of the packing to the bonnet of the steam chest, whereby I am enabled to adjust the packing while the engine is in motion."

85. For an *Improved Mode of Attaching Life Preservers to Vests;* Richard L. Nelson, Ocala, Florida.

Claim.—"I claim the method of arranging a removable life preserver in a vest or other garment, so that it may be worn with or without it, and so that the fastenings of the garment shall serve to secure the life preserver properly to the person."

86. For an *Improvement in the Arrangement of Pencils for Drawing Machines;* Mighill Nutting, Portland, Maine.

Claim.—"I claim supporting a pencil by a tube, so that spiral springs may be made to operate in pressing the pencil downwards, upwards, or both upwards and downwards, when desirable; the apparatus thus arranged may be supported in a movable frame."

87. For an *Improvement in Sewing Machines;* C. Parham, Philadelphia, Penna.

Claim.—"I claim the shuttle carrier and driver, forming the bearing or seat for the shuttle during its travel, as well as the guide for it on that side coming in contact with the thread loop formed by the needle, and freely admitting of the passage of the shuttle through the loop, when the said carrier is arranged and combined for operation, together with the needle and with the guide plate, or its equivalent, on the needle side of the shuttle, whereby the shuttle is relieved from all friction or rubbing bearing on its thread side of the loop, the thread is prevented from being soiled or injured by lubricating material, and increased freedom of action is given to the shuttle."

88. For an *Improvement in Spinning Frames;* Wm. Perry, Graniteville, S. C.

Claim.—"I claim a movable band or bands, whether made endless or otherwise, of cloth or some other material, so constructed that it may be traversed upon the bobbin rail, under the bobbins, each side, or between the spindles, to graduate the friction under the bobbins, and adjust the drag of the bobbin to suit the yarn being spun upon the frame."

89. For an *Improvement in Manufacturing Wire Rope;* J. A. Roebling, Trenton, N. J.

Claim.—"I claim, 1st, Operating the top wagon by the same driving rope which operates the twisting machines, for the purpose of regulating the advance of the top in proportion to the twist. 2d, The propulsion and operation of the centre strand counter twist machine, by the same driving rope which actuates the main twist machine, for the purpose of insuring a perfect correspondence between the motion of the two machines, and at the same time to insure the proper tension of the centre strand by keeping it exposed to the action of a freely suspended weight. 3d, The combination of the two sheaves with the hollow shaft for operating the endless rope, and to operate the main counter twist machine. 4th, The whole arrangement for operating the main counter twist machine, by means of an endless driving rope, which is kept under a great tension by a suspended weight, and being at liberty to rise, allows the machine to advance as the strands shorten, and at the same time insures a constant and uniform tension. 5th, The peculiar arrangement for lowering the weight box, without slackening the driving rope, by the application of a break friction wheel and check wire, in connexion with a windlass and spur gearing, or the mechanical equivalent therefor, and in combination with the sled and transfer sheave."

90. For an *Improvement in Machines for Threading Screw Blanks;* Elliot Savage, Berlin, Connecticut.

Claim.—"I claim the manner in which the screw blank rest or carriage is moved, in order to form a conical or approximately conical or tapering end to the tail part of the screw blank, in connexion with a cylindrical body and a helix or screw thread thereon, such movement consisting in turning the screw blank with respect to the chaser, and subsequently causing it to descend in a vertical line."

91. For an *Improvement in Furnaces;* J. L. Stevens, Kennington, England; patented in England, Oct 1st, 1852.

Claim.—"I claim supplying the lower fire bars with ignited fuel from the upper bars. Also, the combination of the double fire bars with the plate, for dividing first and then uniting the gases of each, when said fire bars are fed with fuel through one door, and have a fire bridge which is common to both."

92. For an *Improvement in Inhaling Apparatus;* S. H. T. Tilghman, Snow Hill, Md.

Claim.—"I claim the combination of worm tubes, mouth piece, bellows, and distilling vessel, for furnishing medicated air in a comparatively dry state, and assisting the respiration of the patient in inhaling it."

93. For an *Improvement in Clothes Clamp;* Wm. H. Towers, Philadelphia, Penna.

Claim.—"I claim securing clothes or other articles on lines, by impinging or pressing them between the line and the grooved ends of the clamp or button, having a block at its centre through which the line passes out of its usual line."

94. For an *Improvement in Dressing Mill Stones;* T. W. Trussell, Winchester, Va.

Claim.—"I claim the rounding off and polishing the feather edge, or sharp cutting ridge lines of mill stones, and reducing all the intervening burr or granulated face to a smooth surface."

95. For an *Improvement in Lamps;* Isaac Van Bunschoten, City of New York.

Claim.—"I claim the means of confining a thick solar or Argand wick to the metallic wick holder by a finely wove wick or covering. I claim the cone, *d*, in combination with the cone, *e*, and circular plate around the wick tube, to check any sudden draft, and prevent the same passing to the flame."

96. For an *Improvement in Seed Planters;* Milan Waterbury, Cuba, New York.

Claim.—"I claim, in combination with the cap or scroll, the peculiar form of the cells, that is to say, the receiving of the grain into the shallow part of the cell, from whence it gradually shifts into the deeper part thereof, and kept from falling out of the cells by the cap or scroll, by which means the packing or choking of the grain in the cells is entirely avoided."

97. For an *Improvement in Hemp Rotting Processes;* William Watt, Glasgow, North Britain; patented in England, May 22, 1852.

Claim.—"I claim the application to flax, straw, and similar vegetable fibrous substances, of a current of steam and hot water, or hot water alone, at a temperature of not less than one hundred and fifty degrees of Fahrenheit's thermometer, for the purpose of carrying off the volatile matters of such substances, and dissolving and removing their nitrogenous and other extractive matters, without the aid of fermentation, acids, or alkalies."

98. For an *Improvement in Surgical Forceps;* Mary Ann Loomis, Executrix of Jos. G. Loomis, dec'd., Assignor to Wm. A. Gardiner, Philadelphia, Penn.

Claim.—"I claim the improved rotary joint, by means of which the instrument may be introduced with one scoop and blade resting within the other, and the instrument then rotated and opened for operation."

99. For an *Improvement in Scythe Fastenings;* Thos. C. Ball, Assignor to Nathaniel Dawson, Shelbum Falls, Massachusetts.

Claim.—"I claim the slide with its fulcrums and its corresponding recess, in connexion with the leverage of the shank."

100. For a *Presser Bar for Planing Machines;* Harvey Snow, Dubuque, Iowa, Assignor to James A. Woodbury, Winchester, Massachusetts.

Claim.—"I claim combining the presser bar with the rotary cutters, so as to secure the same relative position of the inner edge of the bar and the path of the cutting edge in holding and cutting the surface of a board throughout its varying thickness."

101. For an *Improvement in Apparatus for Drying Clothes;* Stephen Woodward, Assignor to self, Joseph P. Nelson, and Alonzo C. Carroll, Sutton, N. Hampshire.

Claim.—"I claim my improved clothes dryer, constructed so as to enable the series of arms not only to rotate on the post, but to be elevated and depressed, and so as to remove the clothes out of the way of a person, and to carry them into higher atmospheric currents."

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102. For an *Improvement in Hay and Cotton Presses;* Alders Adams, Jerseyville, Ill.

Claim.—"I claim the combination of the rails, mounted on india rubber, or its equivalent, with the block, so that during the descent of the follower the rails will also rise and lift the frame and pressing box up from the block, ready to be wheeled away."

103. For an *Improved Arrangement of Devices for Applying Power to Fire Engines;* G. Backstein, Philadelphia, Pennsylvania.

Claim.—"I claim the peculiar arrangement of the pulling levers, chains, cross-heads, piston, and cylinder, when used as herein described, and applied to the working of a fire engine."

104. For an *Improvement in the Towel or Clothes Horse;* John Cram, Boston, Mass.

Claim.—"I claim the combinatian of hanging frames with their jointed connecting bars, and one or more tension racks, or tension racks and the upright frame, all jointed together and made to fold up or to unfold."

105. For an *Improvement in Clover Hullers;* A. B. Crawford, Wooster, Ohio.

Claim.—"I claim the feeding apparatus ; that is to say, a rubber formed of segments laid on heads and banded, with deep spiral flutes for taking in the seed, the flutes being filled with teeth similar to saw teeth."

106. For an *Improvement in Seats for Public Buildings;* A. Eliaers, Boston, Mass.

Claim.—"I claim actuating the back by the dropping of the tilting seat, so as to bring it into an upright position, by means of the curved arms attached to or forming a part of the frame work of the back, and acted upon by the rear edge of the seat, or a shoulder in the same."

107. For an *Improvement in Feathering Paddle Wheels;* F. Felter, Amboy, N. J.

Claim.—"I claim the combination of the cranked shafts with the vibrating rods and cam-shaped tracks in the wheel house, whereby said partial rotation is attained in a simple manner."

108. For an *Improvement in Converting Reciprocating into Rotary Motion;* C. B. Gallagher, San Francisco, California.

Claim.—"I claim the mode of applying steam power, caloric, or any other motive power that may use the straight cylinder, to machinery, in place of the crank, varying the same to suit different kinds of engines."

109. For a *Rotary Cooking Stove;* Elias A. Hibbard, Winchester, Virginia.

Claim.—"I claim the combining or arranging the reverse manner of draft, the elevating and receding grate, the return flue, the diving and ascending flue, the angular plates for burning coal, and the rotary top."

110. For an *Improvement in Knitting Machines;* J. Hollen, White Township, Pa.

Claim.—"I claim the combination of the series of projecting teeth with the series of needles, arranged and operating for the purpose of regulating the stitches, and making them even. I claim the depresser, so constructed with its inclined sides as to secure the entrance of the barb into the groove of the needle, in case the needle should vibrate or be bent. I claim the separator, arranged and operating as described, for holding the

thread back out of the way of the stitch. I claim the tramper. I claim the thread depresser, in combination with the thrust of the needle. I claim the vibrating feeder."

111. For an *Improvement in Moulds for Pressing Bonnet Fronts;* Whitten E. Kidd, City of New York.

Claim.—"I claim the method of constructing the die with the curved opening in its side, for the purpose of enabling the workman to guide and steady the material of which the front is composed, whatever the sized front may be."

112. For an *Improvement in Steam Boilers;* Daniel B. Martin, Washington, N. J.

Claim.—"I claim the arrangement of the series of tubes placed vertically, or nearly so, between an upper and a lower and connecting vertical water spaces, when said lower water space is made directly over the fire chamber, and the draft is returned over said lower space and among the vertical tubes."

113. For an *Improvement in Tanks and Cisterns for Supplying Locomotives;* A. W. McDonald, New Creek Depot, Virginia.

Claim.—"I claim, 1st, A water tank, (from which to supply locomotive steam engine boilers with water,) so constructed that it may become, at the will of the engineer in charge of it, an exhausted receiver, as the water is pumped out of it by the engine, and when so exhausted, may be replenished through the pipes, hose, &c., with which I provide it, either when at high speed upon its way, or when brought to a halt. 2d, An improvement upon the tank or tanks, in common use, (for the supply of locomotive steam engine boilers with water,) by providing them with what I have called a tank pipe, trough pipe, guide wheel, and controlling cord, or other equivalent mechanical agents or aids, by which such tanks may be replenished whilst moving at high speed from my cistern. 3d, A new and improved road-side cistern, constructed so that any tank of the construction now commonly used, with my improvement attached, as well as my own tank, may be replenished whilst passing said cistern at high speed, and my own tank, if in an exhausted state, may be replenished, either when under way at any speed, or brought to a halt by the side of said cistern. 4th, My own tank, in connexion or combination with my cistern; and, 5th, My improved tank, or the tank or tanks in common use, improved as above explained and claimed, in combination or connexion with each other."

114. For an *Improvement in Stoves;* J. L. Mott, Mott Haven, New York.

Claim.—"I claim the extended rim or clothes protector, located and combined with the larger diameter of the fire chamber, that it may serve as a protector to prevent burning clothes when carelessly passing."

115. For an *Improvement in making Metal Rods and Tubes;* James Newman, Birmingham, England.

Claim.—"I claim the production of metallic rods, rails, and bars, having the appearance of solid metal, with a core or centre of sand, sandy, earthy, ashy, or other arenaceous material, and of metal tubes, by afterwards burning or drilling out the core or centre."

116. For an *Improvement in Breech Loading Fire Arms;* A. D. Perry, Newark, N. J.

Claim.—"I claim the employment of the revolving segmental breech, having its centre of motion below, and in the line of the face of the breech of the barrel, and a central plug to fit the bore of the barrel, so that when the breech piece and breech of the barrel are brought together they shall fit. Also, in combination with said breech piece, the levers. And, also, in combination with said arrangement or system of levers, the recess in the stock of the arm."

117. For an *Improved Machine for Boring the Chambers in the Cylinders of Fire Arms;* E. K. Root, Hartford, Connecticut.

Claim.—"I claim forming the chuck with a circular eccentric plate, having a recess to receive the block of metal to be drilled or reamed, or either, combined with the body of the chuck, and with a bolt, or its equivalent, so that by turning the said eccentric plate on the body of the chuck, the several holes to be drilled, bored, and reamed, or either, can be brought successively and held in line with the axis of rotation of the mandrel. Also, in combination with the said eccentric plate of the chuck, the radial sliding

gripes operated by the conical surface of the screw ring, for holding and liberating the block of metal, by simply turning the said ring, by means of which the block can at all times be held in the centre of the eccentric plate. Also, the eccentric chuck, in combination with the series of sliding tool carriers, arranged in a circle, so that by turning the series, the several tools can be brought successively in a line with the axis of the mandrel."

118. For an *Improved Piano Forte Action;* Daniel H. Shirley, Boston, Mass.

Claim.—"I claim giving the blow to the hammer, and keeping it always in readiness for a blow, by means of the vertical arm and diagonal arm actuated by the butt. Also, so arranging the back catch as to actuate it by the return of the block on the end of the diagonal arm after each blow."

119. For an *Improvement in Moulds for Pressing Bonnet Frames;* Nathaniel Spence, City of New York.

Claim.—"I claim the arrangement of the metallic die and counter die, with their respective heaters, whereby the dies can be removed without disturbing the heaters, or the heaters removed or changed without opening the dies."

120. For an *Improvement in Looms for Weaving Bags;* Wm. Talbot, Sanford, Me.

Claim.—"I claim, in combination with the jacquard apparatus, or series of lifters, their lifting mechanism and the rotary regulator, pin wheel, or cylinder, or its equivalent, the secondary regulator pin wheel or cylinder, or its equivalent, and a mechanism for imparting to the secondary pin wheel or regulator, its proper motions and intervals of rest, whereby, by the combined action of both regulators, the weaving of the bag and the bottoming of it is carried on, my machinery being adapted to the weaving of plain twilled, or fancy work, as occasion may require."

121. For an *Improved Mitre Box;* William Tinsley, Glens Falls, New York.

Claim.—"I claim the hollow grooved central cylinder, adapted to carry saw guides, said cylinder turning upon a pivot in a hanging adjustable fulcrum, combined with the lumber box, whose back and bed can be adjusted to different angles."

122. For an *Inclined Sliding Valve;* Edward H. Tracy, City of New York.

Claim.—"I claim the shoe attached to or constituting an enlargement of the side of the valve adapted to sliding on the inside of the case, and admitting of a horizontal or inclined position, and action of the stop cock."

123. For an *Improved Rotary Lathe;* George Tugnot, City of New York.

Claim.—"I claim arranging one or more slide rests, to which the cutting tools are attached, within a rotating cylinder."

124. For a *Planing Machine;* Daniel Van Fleet, Sandusky City, Ohio.

Claim.—"We claim, 1st, The employment of the ogee form in the throat of the plane, so as to make a part of that throat, and not otherwise, of such a size that the swelled part of it shall so meet the shaving as to prevent its curling, and pass it outwardly to the depressed part of the form, which discharges it freely without clogging. 2d, The radial arms, in their combination in pairs with the frames carrying the feed rollers and the planing knives."

125. For an *Improvement in Metal Drills;* Wm. Wakely, Homer, New York.

Claim.—"I claim providing the crank with a sliding handle, and arranging the pinion on the same, so that it may be thrown into gear with one or both of the wheels, as occasion may require. Also, the arrangement and combination of the pinion, spur wheels, and drill stock, when provided with a screw. I likewise claim, for the purpose of facilitating the change in the feed of this particular drill, of the wheel in sections, and the substitution of a section having a greater number of teeth, for one having a lesser number."

126. For an *Improvement in Sewing Machines;* T. E. Weed, Williamsburg, N. Y.

Claim.—"I claim the vibrating spring fly, whether adjustable or not, for taking up the slack of the thread during the descent of the needle, and releasing the thread as the needle enters the cloth."

127. For an *Improvement in Washing Machines;* Wm. Wheeler, Acton, Mass.

Claim.—"I claim the method of giving motion to the dasher of a washing machine, by means of the eccentric operating against the elastic plates."

128. For an *Improvement in Windlasses;* Henry Richards and Charles F. Windsor, Boston, Massachusetts.

Claim.—"We claim the screw detached from the windlass and encircling it, by which the cable is caused to fleet itself by the turning of the windlass in heaving in."

129. For an *Improvement in Binding Guides for Sewing Machines;* O. G. Boynton, Haverhill, Assignor to Nehemiah Hunt, Boston, Mass.

Claim.—"I claim so combining with or fixing it on the presser, that it (the said guide,) may be lifted with and by the presser. and rise and fall with it, so as to accommodate the guide to the varying thickness of the material while the sewing of the binding on such material is being effected, and also to support such guide so that it may offer no such obstruction to turning of the cloth on the base plate as it would present were it supported directly on the base plate."

130. For an *Improvement in Sewing Machines;* Thomas J. W. Robertson, Assignor to self and E. A. Beach, City of New York.

Claim.—"I claim, 1st, Making the interlocked stitch by causing the needle to pass its thread over a stationary thread case, in which the other thread is contained. 2d, The combination of the thread case with the thread case holder, by means of a spring, or its equivalent, that is to say, when so arranged as that while the spring holds the thread case securely in place, the thread case holder and spring shall permit the needle thread to be drawn around the thread case to form the stitch. 3d, The combination of the sliding frame, needle bar, and movable case. 4th, The combination of the feeding bar, having a plate and feed roller, with the sliding frame."

131. For an *Improvement in Making Rope and Cordage;* Arad Woodworth, 3d, Boston, Massachusetts, and George Chamberlin, Olean, New York.

Claim.—"We claim, 1st, The arrangement of the bevel gears, or their equivalents, with their guiding holes for conducting each thread, arranged outside of the centre of the said gears, as set forth, whereby a draft is created upon each thread separately, and the threads in the several spool frames are prevented from being twisted or formed into strands, until they are brought together and drawn out of the last spool frame. 2d, We claim giving the strands, after they are formed, a revolution at the same time and in the same direction that the laying up machinery revolves, for the purpose of preventing the twist first given from being partially lost or broken out, by the process of laying them up. by which each strand retains the same amount of twist that was imparted to it by the twisting machinery, thus forming an even and hard twisted rope."

Additional Improvement.

1. For an *Improvement in the Construction of Reed Musical Instruments;* F. A. Gleason, Rome, N. Y.; dated Nov. 14, 1854; additional to patent dated June 20, 1854.

Claim.—"I claim the application of hammers to reeds, operated as described, or by any similar method producing the same result."

Re-Issues for November, 1854.

1. For an *Improvement in Winnowing Machines;* Samuel Canby, Ellicott's Mills, Maryland; dated Nov. 14th, 1854; originally dated Dec. 28, 1852.

Claim.—"I claim the automatic graduation of the fan blast, by means of a piston in a passage communicating with the fan case, balanced by weight, to support the atmospheric pressure due to the rarefaction produced by a given velocity of the fan, but movable when said velocity varies, and by connexion with valves regulating air passages so operating them as to diminish the capacity of said passages when the velocity of the fan is too great, and produce the contrary effect if the blast be weakened by a diminished velocity of the fan."

2. For *Improved Rake to Harvesting Machines;* Sylvanus Miller, Urbana, Ohio; dated Nov. 21st, 1854; originally dated July 15th, 1851.

Claim.—"I claim the guide, arranged in connexion with the tilting roller, for the guidance of the rake in a path similar to that which it would receive from the human hand, by which it removes, periodically, the grain or grass from the bed, and frees itself by the retraction of the teeth endwise. Also, the application of a thin light roof to the rakes for harvesters, for the purpose of effecting the separation of the gravel from the falling grain."

Designs for November, 1854.

1. For a *Bar Room Stove;* Jacob Beesley, Assignor to W. P. Cresson & Co., Philadelphia, Penna.; dated Nov. 7th, 1854; ante-dated May 7th, 1854.

Claim.—"I claim the design for bar room stove, as set forth."

2. For *Egg Stoves;* David Stuart, Assignor to W. P. Cresson & Co., Philadelphia, Pennsylvania; dated Nov. 7th, 1854; ante-dated May 7th, 1854.

Claim.—"I claim the design for egg stove."

3. For *Wire Fences;* Matthias Lachenmaier, Philadelphia, Pa.; dated Nov. 21, 1854.

Claim.—"I claim the combination and arrangement of the horizontal twists above and below the rosettes, forming, together with the wire and rails, an ornamental design for a wire fence, characterized by a horizontal row of rosettes combined with the wires, so as to be intermediate or between every two horizontal parallel rows of the horizontal twists."

4. For *Stoves;* Horace W. Robbins, Baltimore, Maryland; dated Nov. 28th, 1854.

Claim.—"I claim the configuration of the radials, in combination with the polished formations, together with the drops and the staminated cornice."

DECEMBER 7.

1. For an *Improvement in Seats for Public Buildings;* A. H. Allen, Boston, Mass.

Claim.—"I claim the seat, constructed, hung, and adjusted, so as to assume and retain the vertical position when not in use, whether by means of the weight or spring, or sliding back, connected and supported by means of the shafts, or by pins or other analogous devices, for the connexion and support of the seat."

2. For an *Improved Oven for Baking;* G. S. Blodgett and P. T. Sweet, Burlington, Vt.

Claim.—"We claim the use of galvanized iron in the construction of ovens, for the purpose of cooking and baking meats and other articles, with this form and kind of furnace."

3. For an *Improvement in Steam Boiler Alarm;* Patrick Clark, Rahway, N. Jersey.

Claim.—"I claim, 1st, The arrangement of the wheel, turning on the screw of the tube, with its rods and caps, or any equivalent device, when actuated by the spring, or its equivalent, in relation to the valve stem and the tube, by means of which the arrangement adjusts itself to the varying length of the tube, as it contracts in cooling after having given an alarm, or after having been used as an ordinary gauge cock. 2d, The arrangement of the bell and disk on the valve stem of the valve of the whistle, when and only when such arrangement is used in combination with the arrangement of the first claim."

4. For an *Improved Arrangement for Reefing Topsails;* H. J. Crandall, Boston, Mass.

Claim.—"I claim the arrangement of the rod with the leaders on the underside of the yard, and the manner of reeving the reef lines and pennants attached to the close reef through the leaders connected with the other reefs, and the connecting the reef points with leaders for the reef lines on the after-side of the sail, and the peculiar arrangement together of the aforementioned parts."

5. For an *Improvement in Steering Apparatus;* Joseph D. Crowell, Boston, Mass.

Claim.—"I claim the manner in which I have combined or arranged the operative parts of the said steering apparatus, the rudder head, and the tiller, the bearings of the steering wheel being supported directly on the upper end of the rudder, and that of the tiller, while the curved rack is elevated above the deck, and to or about to the level with the top of the rudder head and tiller, such not only enabling a single pinion and rack to be used in connexion with the steering wheel shaft, sustained as specified, but rendering the whole apparatus simple and efficient in operation, and very cheap in point of construction, and little liable to get out of repair."

6. For a *Rotary Pump;* Joshua Gray, Boston, Massachusetts.

Claim.—"I claim the combination of the two flat cones and the flexible diaphragm or partition applied together, and in a case provided with ingress and egress pipes or orifices, such cones being arranged in contact, and with their axes at an angle to each other, and the whole being made to operate together."

7. For an *Improvement in Railroad Car Seats;* John T. Hammit, Philadelphia, Pa.

Claim.—"I claim, 1st, Placing the legs or wheels, or wheels in the legs, in such a position in relation to the pivot on which the seat revolves that as the seat is turned, they, the legs or wheels, shall not run into or across any sockets except those in which it is intended they shall stop. 2d, Placing the pivot near the front edge of the seat, so that it may be made longer and turned without coming in contact with the side of the car, thereby permitting the seats to be made longer and arranged to turn in a car of a given width, without reducing the width of the avenue or space between the ends of the seats."

8. For an *Improvement in Railroad Switches;* Samuel P. Kittle, Buffalo, N. York.

Claim.—"I claim the moving of the switch by the passing train, through the intervention of a slotted cam, which will move and then hold or lock the switch to either rail against the lateral pressure, without the use of any other device than the slot, pin, and pivot."

9. For an *Improvement in Machinery for Separating the Fibre from the Woody Portions of Tropical Plants;* John Lilley, Birkenhead, England; patented in England, July 21st, 1853.

Claim.—"I claim the combination of the yielding knives or scrapers with the rollers, when said knives or scrapers are hung on a toggle joint and operated by cams, and thrown out of or into action with said cams by weighted levers, first to receive the material, and then to divest it of the refuse matter."

10. For an *Improved Machine for Rounding the Backs of Books;* Leonard F. Markham, Cambridgeport, Massachusetts.

Claim.—"I claim, 1st, The combination of a presser bar hung upon proper journals, with a yielding table upon which the book is placed, the back of the book being shaped by the action of the said presser bar and table. Also, a presser bar hung upon sliding journals, and actuated by the friction rollers and curved guides, so as to give a forward motion to the said presser bar, and thereby adapt the machine to rounding the backs of thick books."

11. For an *Improvement in Paper Making Machines;* Obadiah Marland, Boston, Mass.; patented in England, September 28th, 1854.

Claim.—"I claim vibrating the revolving cylinder mould, and the parts immediately connected therewith."

12. For an *Improvement in Paper Making Machines;* Obadiah Marland, Boston, Mass.; patented in England, September 28th, 1854.

Claim.—"I claim producing within the vat of a cylinder paper making machine, currents and counter currents of the pulp, parallel or nearly so to the axis of the cylinder, by the use of spiral conveyors operating within the partitioned shell, or by means of their mechanical equivalents."

13. For an *Improvement in Wash Stands;* W. H. Miller, Brandenburg, Kentucky.

Claim.—"I claim a wash stand made in sections, and having its parts constructed so

as to form a clear water reservoir, a waste water reservoir to receive the waste water from the basin, rim basin, and table top."

14. For an *Improved Mill for Shelling and Grinding Corn;* Henry R. Miller, Louisville, Kentucky.

Claim.—"I claim the construction and arrangement of the circumscribed or inclosed concave, having their draft shoulders of equal depth, or thereabouts, and made with an abrupt stop on their outer corner, by the junction of the outer boundary line of the concave with the shoulder, when combined and operating together with the adjusting bosom in the other stone, and extending to cover or act over the whole surface of the concave, whereby the ears of corn fed into between the stones promiscuously, and several at a time, are prevented from passing out of the concave otherwise than over the draft shoulder, and are gradually turned, borne, or otherwise pressed by the bosom against the draft shoulder to an equal extent of contact therewith throughout their length, for the better adjustment of the several ears into a proper crosswise position for 'shelling' and travel between the inner furrowed surfaces of the stone."

15. For an *Improved Machine for Crushing Ores;* Wm. H. Plumb, City of N. Y.

Claim.—"I claim the rollers upon the radial arms of the shaft, connected with the movable arms, or their equivalent, and revolving in a basin whose inner surface is eccentric to the roller's shaft."

16. For an *Improvement in Steam Boilers;* John A. Roebling, Trenton, N. Jersey.

Claim.—"I claim the arrangement of the extended grate surface, elaborating or central combination chamber, the tube sheets, and the tubular water surface between the said sheets."

17. For an *Improvement in Railroad Car Brakes;* Michael Shimer, Uniontown, Pa.

Claim.—"I claim the inclined curved bar and elliptical spring, in combination with the elastic chain and the slotted bar, for the purpose of preventing a concussion when the car wheel strikes the curved bar and spring, and also for the purpose of preventing the shoe from being broken."

18. For an *Improvement in Dry Docks;* James E. Simpson, East Boston, Mass.

Claim.—"I claim the method of constructing dry docks, by making use of the natural stratum of clay for the floor of the dock, and continuing the same up through the walls by means of puddling, the front of the dock being furnished with gates for the admission of the vessel."

19. For an *Improvement in Casting Metal Window Sashes;* T. J. Sloan, City of N. Y.

Claim.—"I claim moulding and casting metallic window sashes with auxiliary bars, substantially as herein specified, to keep the rails straight during the contraction of the metal in cooling, and then to be cut or broken out."

20. For an *Improvement in Running Gear for Railroad Cars;* David G. Smith, Carbondale, Pennsylvania.

Claim.—"I claim a six-wheeled truck, having on that end of it next the end of the car, a pair of wheels with semi-conical treads and no flanches, and united to the truck frame, which is also supported on two other pairs of wheels of the ordinary construction, by the supporting plate, king bolts, and connecting rods, so that said pair of wheels may have a lateral motion on the rails, independent of the other pairs, and yet support their due proportion of the weight of the car."

21. For an *Improvement in the Manufacture of Brushes;* M. Stewart, Philada., Pa.

Claim.—"I claim the use, in combination with conical or enlarged tubes, of a wire for binding the knot of bristles before their insertion, the said wire being supported or held by coming in contact with the sides of the tubes, or suitable projections thereon."

22. For a *Method of Extinguishing Fire in Inaccessible Places;* Amasa Stone, Philadelphia, Pennsylvania.

Claim.—"I claim, 1st, The arrangement of the rotating or oscillating reservoir furnished with the jets connected with exterior water pipes, and operating so as to diffuse jets or streams of water. 2d, The peculiar combination of reacting arms, valve, and

reservoir, by which, in one modification of my apparatus, the desired rotation or oscillation is effected."

23. For a *Mode of Regulating the Furnaces of Hot Water Apparatus;* T. T. Tasker, Philadelphia, Pennsylvania.

Claim.—"I claim the arrangement of the two sets of floats operating the valve and damper, and the open vessel, in combination with a circulating hot water apparatus."

24. For an *Improvement in Covering Cotton Thread with Wool;* James Taylor, Newark, New Jersey.

Claim.—"I claim the employment of the rubbing rollers, in combination with the arrangement of mechanism, for uniting the bands of wool around the cotton thread."

25. For an *Improvement in Lanterns;* Wm. D. Titus, Brooklyn, New York.

Claim.—"I claim the combination with the lantern case of the slotted cover, which is so arranged as to fall by its own gravity, and fit upon the match holder during the operation of lighting the lamp."

26. For a *Hydraulic Ram;* Ellis Webb, Parkersville, Pennsylvania.

Claim.—"I claim, 1st, The valve, composed of a hollow cylinder having its upper end open, and its lower end closed, and extending up above the water and packing line, so that in rising it will rise against the air instead of the column of water within the air chamber. Also, the method herein described, of introducing the oleagenous packing, or its equivalent, on top of the water in the chamber, for the purpose of preventing the water from taking up and carrying out with it the air which should be contained therein. Also, in combination with the rising main or discharge pipe, the check valve for preventing any re-action in said pipe from extending back into and endangering any of the operating parts of the machine."

27. For an *Improvement in Churns;* Elbridge Webber, Gardiner, Maine.

Claim.—"I claim the combination of the flanched inverted conical dasher with the inverted conical cream chamber."

28. For an *Improvement in Grain and Grass Harvesters;* Cyrenus Wheeler, Jr., Poplar Ridge, New York.

Claim.—"I claim the hanging the cutter bar, provided for the purpose with a socket, to one extremity of the arched bar by means of joints and segments, said arched bar being in its turn pivoted to the main frame, all for the purpose of giving the cutter bar, by meana of levers, a motion independent of the frame, and both rotating longitudinally parallel to the ground, and oscillating radially from the joints, in order to adapt the same to the inequalities of the ground, or to stop its action at pleasure."

29. For an *Improvement in Dry Gas Metres;* Franklin Darracott, Assignor to George Darracott, Boston, Massachusetts.

Claim.—"I claim the use of measuring chambers arranged in pairs, as described, and similarly inclosed by means of the flexible leather secured to the stationary and movable diaphragm, the latter between the chambers, and forming one side of each of them, and connected to the parts which they are to actuate, by means of attachments to their peripheries. 2d, In combination with the measuring chamber of a dry gas metre, the within described rotating valve, with its inlet and outlet passages, constructed and operating as set forth. 3d, Opening a communication between the space which surrounds the measuring chambers and the inlet pipe, when the registering takes place only from the gas within the chambers, whereby an equal and uniform pressure exists at all times upon both sides of the leather which unites the diaphragm, and all loss of gas by transmission through its pores is avoided."

30. For an *Improvement in Knitting Machines;* John Pepper, Jr., Portsmouth, N. H., Assignor to the Franklin Mills.

Claim.—"I claim combining an annular series of hooked needles and a series of radial and sliding hooked needles, so as to operate together, and with a rotary toothed wheel or sinker, and two rotary presser wheels, and produce ribbed work. Also, the improvement of making a part of the cam or lip of the cam plate adjustable, for the purpose of removing a needle of the second series from the seat, when necessary or desirable. And, also, the arrangement of the second series of needles, with respect

to the other or first series, that is to say, the so arranging them that their plane shall cut that of the upper ends of the needles of the first set, and dips below and rises above the same, as stated, such an arrangement causing the stitches of the first set of needles to be elevated and cast off or over the loops or yarn of the second set, by the lifting power or action of the series during the rotary movement."

31. For an *Improved Lubricating Apparatus;* J. Regester, Assignor to E. Clampitt and J. Regester, Baltimore, Maryland.

Claim.—"I claim the combination of the reservoir for containing the oil or lubricating fluid with the central conical stem or spindle, by means of two sockets or bearings, one of which is at the upper and the other at the lower or bottom part of the reservoir, in which sockets there are pssages corresponding with other passages or vents in the bearings of the central stem, which top and bottom passages are alternately opened and shut by the moving of the reservoir around the central stem."

32. For an *Improved Quartz Crusher;* J. W. Cochran, City of New York, dated Nov. 28th, 1854; patented in England, Nov. 21, 1853.

Claim.—"I claim, 1st, The movable dies or bushings, either with or without the india rubber, or other elastic interlining or cushion, in combination with the revolving disk or plate, and balls or shells. 2d, The manner of arranging and stretching the wire gauze or screen in pannels, and securing them to the standards so as to give a uniform surface to the inner surface of the screen. 3d, The connecting shaft for coupling the driving shaft with the revolving plate or disk, admitting the revolving plate or disk to vibrate laterally or vertically without affecting the driving shaft or its bearings."

DECEMBER 12.

33. For an *Improvement in Polygraphs;* Nathan Ames, Saugus, Massachusetts.

Claim.—"I claim the horizontal parallel wires, and the connecting wires, so that by means of themselves the pen holder may be supported and guided with as little complexity, weight, friction, and liability of getting out of repair as possible, the simple weight of the wires and pen holder always preventing the joints from wearing loose, and the elasticity of the wires always supporting the wires at a small but equal distance from the surface of the paper whenever they are not pressed down by the operator in writing, copying, or drawing,"

34. For an *Improved Polygraph;* Nathan Ames, Saugus, Massachusetts.

Claim.—"I claim, 1st, Arranging two or more tables, one above the other, for the purpose of writing simultaneously on two or more sheets of paper. 2d, Arranging two or more pens, one above the other, in the end of a forked pen holder, consisting of as many prongs as there are tables, all the pens being moved and guided simultaneously in the same, and in any direction. 3d, Arranging one ink stand above another, as described, in order that all the pens in the different prongs may be supplied with ink at the same time. Lastly, the method of confining the sheets of paper, or the leaf of a book, to the under table or tables."

35. For an *Improvement in Operating Looms by Electricity;* Gaetan Bonelli, Turin, Sardinia; patented in France, August 15th, 1853.

Claim.—"I claim, 1st, The application of electricity, or of electro-magnets, to power looms, in order to raise and keep in an elevated state the hooks and heddles, in the required order to form the design or pattern of fashioned stuffs, such as shawls, carpets, ribbons, &c. 2d, The various means of making such designs on metallic surfaces, by means of an insulating material, and the use for this purpose of varnish of weavings of paper painted or colored with metallic substances, of paper cut out or pinked or pierced, &c."

36. For an *Improvement in Hanging Carriage Bodies;* B. F. Brown, Dorchester, Mass.

Claim.—"I claim the combination of the spring and perches for sustaining the weight of the carriage body, and for relieving the said carriage body from sudden jolts, the combined action springs and perches being such as to give an easy and elastic motion to the carriage body. I claim the combination of the springs, perches, and thorough braces, the said thorough braces operating to give an easy motion to the carriage body, and preventing the swaying of the said carriage body from twisting or bending the spring."

37. For an *Improvement in Oscillating Steam Engines;* Mathew Cridge and Samuel Wadsworth, Pittsburgh, Pennsylvania.

Claim.—"We claim the arrangement of adjusting the side pipe of an oscillating engine by means of set screws, to act directly on the places where the steam reacts on, viz: opposite the steam and escape openings in the surfaces of the side pipe, and of resisting at the same time the reacting power of the steam against the side of the cylinder by means of a counter set screw, or by any other means being for the same purpose. The set screw and counter set screw forming a complete system of regulation, for the purpose of keeping the surfaces between cylinder and side pipe steam tight, and adjusting the position of the cylinders."

38. For an *Improvement in Machines for Bending Metals;* William W. Cumberland, Newark, New Jersey.

Claim.—"I claim, 1st, The arrangement and connexion, in any manner, of the parts termed respectively, the bed, the down-hold, and the die-piece, and employed, the two former for holding the slat or piece of metal to be operated upon, and the latter for holding the die or dies, whereby the resistance of the slat or piece operated upon, to the bending or forming operation, causes it to transmit the power necessary to produce the pressure for holding it. 2d, Furnishing the down-hold or movable holding part with a catch, which is so formed and arranged that it may be brought to a suitable position on the die-piece, or on an arm attached thereto, when the die-piece has moved back to a certain distance after the die has done its work, and thereby attach the down-hold to the die-piece, so that the former is raised by the movement of the latter, and thus caused to liberate the slat, or other articles which it has held in place. 3d, Controlling the operation of the catch so that it shall only catch the die-piece during every second return movement, or after it has made as many movements as may be necessary to produce the required form on the slat or other article, by means of the lifter wheel, ratchet, and click piece. 4th, Constructing the back part of the face of the down-hold with a series of projections and recesses, and the front of the die-piece above the die, with similar projections and recesses, fitting to the projecting recesses on the down-hold, for the purpose of affording support to the upper side of the slat or piece on the side opposite the bend, during the bending operation, and allowing the die to work up as close as is necessary to the edge of the bed and down-hold. 5th, The employment of two or more dies of different depth, or of different form, arranged in or upon a roll, which has such movements on its axis as to bring the said dies successively into operation upon the slat, or other article, whereby a form requiring two or more distinct operations of the die to produce it, is produced on the slat or article without releasing it. 6th, Attaching the back-hold plate, which regulates the position of the slats on the bed, to the bed by springs of any suitable description, for the purpose of allowing it to yield to the movement which the slat is caused to receive upon the bed by the tightening of the down-hold, and for allowing the movement which is given, for the purpose of throwing out the slat. 7th, Furnishing the back-hold plate with a flap piece, hinged to it so as to be thrown down on the bed at pleasure, for the purpose of regulating the position of the slat when the second scroll is to be formed, and compensating for the reduced width of the slat caused by the bending of the first scroll. 8th, Giving to the back-hold plates the necessary movement to expel the slat or piece after the scroll or other form is produced on either edge thereof, and suddenly leaving it free to be returned by the action of the springs to the proper position to adjust a new slat or piece upon the bed, by connecting it with a lever which is furnished with a springing piece which is operated upon by pieces attached to the down-hold, every time the latter moves to liberate a slat or piece. 9th, The arrangement of dies relatively to the arc described by the axis of the die roll, whereby the resistance of the metal to the bending or forming operations of the two dies is made to act in such a direction as to cause the die to have a tendency to turn on its axis in the proper direction to bring the projecting piece into contact with the stop, as may be required. 10th, The method of turning the die roll back and forth to change the positions of the dies, by means of catches, which are attached to the bed, and stand in such positions that when the die-piece swings back, they catch on studs attached to the die roll at a distance from its axis. 11th, Attaching the studs to a pair of levers which are attached to the die roll, and are so formed, and arranged and controlled by a spring, that when the studs are caught by catches which turn the die roll on its axis, the levers are caused to act upon a double pawl, which is so arranged as to fall behind either of two projecting pieces on

the die roll, for the purpose of holding it against one of two fixed stops, and to move the said pawl so as to release one of the projecting pieces, and fall behind the other, and thus release the die roll from the position in which one die is operative, and secure it after it has been moved to the position in which the other die is operative. 12th, The arrangement of the preparatory dies relatively to the bed, the down-hold, and the die-piece which carries the bending dies, whereby the attendant is enabled to conduct the operations of the preparatory dies upon one slat, and the bending dies upon another slat at the same time."

39. For an *Improvement in Machines for Crushing and Grinding Minerals and other Substances;* T. O. Cutler, City of New York.

Claim.—"I claim combining with the rotating pan or shell, having a rim against which the substance to be crushed or ground is distributed and held by centrifugal force, one or more wheels with rounded or beveled treads, and turning on axes radiating or nearly so from the axis of the fan or shell, and whose planes of motion are tangent to a circle of less diameter than the rim of the pan."

40. For an *Improvement in Throstles for Spinning Cotton;* Charles Danforth, Paterson, New Jersey.

Claim.—"I claim the connecting together the spindle rails from side to side of the frame, in two or more sections, connecting the guards and guide wire boards with the spindle rails, so that they will traverse with them, and constructing and arranging the transverse movements so that the different sections will counterbalance each other."

41. For an *Improved Method of Destroying Vermin;* G. W. French and Wm. Wagstaff, Cambridge, Massachusetts.

Claim.—"We claim the use of a current of steam issuing from a boiler under high pressure, in such manner as to mix with a current of heated air, and to drive the mixture forcibly forward in a somewhat confined state until it comes in contact with furniture, fabrics, *&c.*, in order rapidly to heat the surfaces and crevices, for the purpose of destroying vermin, without injury to either cabinet ware, woolen, or other fabrics."

42. For an *Improvement in Hoes;* Moses Gates, Gallipolis, Ohio.

Claim.—"I claim the construction of the tube or socket with a shoulder on the end to be attached to the blade or plate, the attachment of the same to the plate by drawing it through the plate and hammering down the end of the tube so as to form a burr or rivet head on the outside of the plate, and the more firm attachment of the tube or socket to the plate by soldering or brazing."

43. For an *Improvement in Coffins;* John Good, Philadelphia, Pennsylvania.

Claim.—"I claim the collar and the reservoirs, in connexion with the pipes and the various parts, being arranged as set forth."

44. For *Improvements in Harrows;* E. L. Hager, Frankfort, New York.

Claim.—"I claim the manner of securing the harrow teeth to the frame, in combination with the means employed for making said teeth capable of being adjusted from a vertical to an oblique position, and of being set to any depth desired."

45. For *Angler's Combined Float and Sinker;* J. W. Hoard, Providence, R. Island.

Claim.—"I claim making the sinker hollow, and providing one end thereof with an aperture through which the interior may be loaded and unloaded."

46. For an *Improvement for Securing Carpets to Floors;* E. Jackson, Portland, Conn.

Claim.—"I claim the hook, hooks, or claws on the loop, by which said apparatus may be attached to when fastening carpets to floors, or detached from when taking them up, at pleasure."

47. For an *Improvement in Hub Bands for Carriages;* J. Jenkins and J. R. Cooke, Winsted, Connecticut.

Claim.—"We claim the combination of the serrated projections with the inclined planes, and one or two spring clicks or dogs."

48. For an *Improvement in Flyers;* Edward C. Johnson, Lowell, Massachusetts.

Claim.—"I claim the arrangement and combination of the pin (fastened in the end of the arm of the flyer by a set screw,) in connexion with the spiral spring, in such a

manner as to render the presser easily adjustable, and so that both the spring and pin shall be contained within the barrel of the presser."

49. For an *Improvement in Cut-off Regulators for Steam Engines;* H. A. Luttgens, Paterson, New Jersey.

Claim.—"I claim operating the cut-off eccentric, which is fitted to turn freely on its shaft, by means of friction produced by the eccentric strap, and the friction produced by a brake strap upon a brake pulley, in connexion with the gearing and segment, the spindle connecting pinion and spur wheel revolving freely in a bearing stationary upon and parallel to the crank shaft, the mechanism receiving its impulse from the revolution of the latter, the whole operating to the effect that any friction produced by the brake strap upon the brake pulley greater or lesser than necessary to counterbalance the friction of the eccentric to turn upon the shaft and alter its angular position to the crank, the brake strap being operated upon by a steam engine governor of common construction."

50. For *Feed Motion for Sawing Light Lumber;* John F. Lovecraft, Rochester, N. Y.

Claim.—"I claim the feed motion for saw mills, said motion consisting of two or more small saws, so united together that the teeth of one come opposite the spaces of the other, and so arranged that they can be adjusted so as to be caused to enter the board to a greater or less depth, as desired, or to be entirely out of the way when the table is being used for a different purpose."

51. For an *Improvement in Sewing Machines;* Wm. Lyon, Newark, N. Jersey.

Claim.—"I claim, 1st, The arrangement of the feeding pieces, that is to say, the rod suspended at one end by an universal joint, so that the unattached end may be permitted to play vertically, and also to rock or vibrate as an axis, and having on said unattached end a feeding finger and arm, in combination with the governing studs upon the wheel. 2d, The clamp in combination with the needle bar, and working in connexion with the feeding finger."

52. For an *Improvement in Propulsion of Vessels;* Henry H. Olds, N. Haven, Conn.

Claim.—"I claim, 1st, The combination of the extension guide bars with the frame, propellers, shifting bars, and cross heads. 2d, The combination of the shifting bars, catch, and shifting float, with the frame."

53. For an *Improvement in Dock Holders for Horses;* Eldridge H. Penfield, Middletown, Connecticut.

Claim.—"I claim fitting a pad upon the rump of the horse near the tail, which may be sustained in its proper position by a crupper passing under the tail, and a strap going forward to be attached to a surcingle or a breast girt, according to convenience, to the rear end of which I attach, by a joint, a spring, and hold it in its desired position by a ratchet and ratchet wheel, and attach this spring to the horse's tail by straps passing round both at suitable distances."

54. For an *Improved Gold Collector;* James Perry, City of New York.

Claim.—"I claim collecting the matter containing gold and other precious substances in the beds of rivers, ravines, gulches, &c., carried along by the force of the stream, by placing in the bottom of such stream a box or other vessel, with a perforated plate at top, and an inclined bottom, discharging into a receiving trunk, or equivalent therefor, so that the particles that pass through the holes in being washed over with the debris by the force of the stream, will gradually descend on the inclined bottom and be discharged into the trunk, whilst the lighter substances floating, will escape through the holes in the top plate. Also, making the holes in the top plate of such an apparatus larger towards the rear end, in combination with the compartments formed by the inclined partitions dividing the inside into compartments with inclined bottoms leading to the trunk. Also, in combination with an apparatus, the employment of a top screen composed of bars to protect the perforated plate from the injurious action of large masses passing over it, and to aid in keeping the holes in the said perforated plate from being clogged. Also, the pocket at the lower end of the apparatus, in which are collected the precious substances that pass over the perforations in the top plate, when this is combined with the said perforated plate, and the compartments and trunk below it. And, finally, the vertical trunk, or equivalent receptacles, and with or without an elevation, in combination with the horizontal trunk, and the compartments below the perforated plate, whereby the

substances collected in the apparatus can be withdrawn therefrom without removing the apparatus from its location."

55. For an *Improvement in Cheese Vats;* Henry A. Roe, West Andover, Ohio.

Claim.—"I claim the combination of the boiler and pipes with the chamber, funnel, and vat, connected with the frame."

56. For an *Improved Hygrometric Regulator for Hot Water Apparatus;* J. H. Ross, City of New York.

Claim.—"I claim the regulating of the hygrometric condition of the air in apartments, by opening or closing the valves in the pipes by the balance lever, its action being self-adjusting through the excess or diminution of vapor imparted to the equipoise, irrespective of the material of which said equipoise is constructed."

57.* For an *Improvement in Looms;* George Roth, City of New York.

Claim.—"I claim suspending the griff frame and the neck board wholly or in part from opposite arms of levers on a rock shaft, or what is equivalent, on cams on rotary shafts, in such a manner that the weight or tension of those cords of the harness which are caught by the griff frame shall be balanced or nearly so by the weight or tension of those which are missed by the said frame, and rest on the neck board."

58. For a *Rattan Machine;* Sylvanus Sawyer, Fitchburg, Massachusetts.

Claim.—"I claim the combination of a mechanism for dressing the enamelled side of the strand of rattan, and a mechanism for reducing a strand to its proper thickness. Also, the combination of a mechanism for reducing the strand to a proper thickness, and a mechanism for reducing it to its proper width. Also, the combination and arrangement of a mechanism for reducing the enamelled surface or side of the strand, or removing the joints or other protuberances therefrom, a mechanism for reducing a strand to its proper thickness, and a mechanism for reducing it to its proper width, the same being made to act together automatically."

59. For an *Improvement in Sewing Machines;* Geo. W. Stedman, Vienna, N. York.

Claim.—"I claim the tube, receiving thread and acting in combination with the needle, so that each forms a series of loops, each of which loops receives one, and is received by the next one of the other series."

60. For an *Improvement in Seed Planters and Cultivators;* D. W. Shares, Hamden, Conn.

Claim.—"I claim connecting the wings or shoes to each other and to the frame of the machine, in such manner that they are made capable of universal adjustment by hanging them so that they may be turned on extension bars, or rods projecting horizontally from the rear hinge, and uniting them together, or otherwise equivalently hanging and connecting them, so that the wings or shoes may not only be expanded and contracted to vary their width apart, but may also have their depth of entry into the ground, and angular set in direction of their depth varied to suit various widths of the wings apart, and various conditions of the soil or other controlling circumstances. And, further, the arrangement of the beveling or finishing plate operating in rear of the covering portion of the wings, to slightly flatten the tops of the rows, and give a neat and substantial finish to them."

61. For an *Improvement in Machinery for Scraping Metals;* J. Stever, Bristol, Conn.

Claim.—"I claim the arrangement of the driving shaft, the connecting rod, the slotted lever and its fulcrum lever, in connexion with the rod and its rocker shaft, the whole being for giving the scraper the double motion, and regulating the same."

62. For an *Improvement in Processes of Treating the Mother Water of Salines;* Edward Stieren, Tarentown, Pennsylvania.

Claim.—"I claim the process for treating the bitter water of such of the salines of the United States, for the purpose of obtaining epsom salts, (or sulphate of magnesia,) iodine, bromine, and a portion of refined table salt."

63. For a *Boring Machine;* Benjamin F. Taft, South Groton, Massachusetts.

Claim.—"I claim the method of arranging and reversing the longitudinal motion of the boring tool automatically, so as to bore the holes accurately to the required depth, and then withdraw the boring tool. Also, the peculiar construction of the teeth of the

rack and wheel, whereby they can be suddenly, and at any point during the descent of the tool engaged to arrest the boring at the instant required, and also so that in reversing the motion of the crank to turn the screw point of the auger out of the wood, the rack will yield to let the teeth of the pinion slip until the screw point is withdrawn, when, by reversing the motion of the cranks, the auger will be raised out of its hole. Also, the combination of the projection on the carriage with the adjustable arm and the bolts, whereby the rack is released and left free to engage with the wheel, when the boring tool has descended to the required depth. Likewise, the combination of the projection on the carriage with the spring lever and the thumb lever, whereby the carriage is held up when the boring tool is withdrawn from the wood, and the boring suspended, and when it is required to resume the boring, the rack is disengaged from the wheel, and the end of the lever withdrawn from beneath the projection to leave the carriage free to ascend."

64. For an *Improvement in Condensers for Steam Engines;* H. Waterman, Hudson, New York.

Claim.—"I claim the mode of forming and placing the tubes of a condenser, by the employment of collars, either with or without the conical pierced tube sheet, and made at the joints air tight, by means of the india rubber packing, or its equivalent."

65. For an *Improved Hot Air Furnace;* Daniel P. Weeks, Malden, Massachusetts.

Claim.—"I claim the combination and arrangement of the extended flame chamber, (leading out of the fire-pot,) the two sets of lateral horizontal radiator pipes, the connexion pipes, the radiator pipe, and the flue or pipe connected with the fire chamber and pipe."

66. For an *Improvement in Door Locks;* Jacob Weimar, City of New York.

Claim.—"I claim the employment or use of the two sets of slotted circular tumblers, toothed wheels, disk, and pawls, one set being placed upon a shaft attached to the bolts, and the other set placed upon a shaft attached to a sliding plate, so that when the bolt is thrown forward, both sets of tumblers will be thrown in gear with the toothed wheels, and thereby allowing the slats in the tumblers being moved so as to be out of line with the projections, the pawls preventing the wheels being moved until the disk is also turned or moved the proper distance, and thus preventing the lock being picked by tampering with, or trying the tumblers, in order to get a pressure of the bolt thereon."

67. For a *Machine for Dressing Felloes;* Charles W. Wyatt, Newburgh, New York.

Claim.—"I claim, 1st, The method of dressing, which consists in securing the felloe within a horizontally rotating frame, and subjecting the felloe to the action of suitable cutters during said rotation, the axis of the frame and consequently the curve of the felloe being changeable at pleasure. 2d, The combination of the cutters and stocks. 3d, The combination of the spring with the lever and standard."

68. For an *Improvement in Ships' Windlasses;* David L. Winsor, Duxbury, Mass.

Claim.—"I claim forming on the surface of the barrel of a windlass, a series of spiral scores or grooves to fleet the chain. Also, placing friction on the larger and inclined portion of the windlass barrel, for the purpose of aiding in fleeting the chain."

69. For an *Improvement in Seed Planters;* John Andrews, Assignor to himself, N. A. Richardson, and Gardner Symmes, Winchester, Massachusetts.

Claim.—"I claim, 1st, The swinging or seed sower. 2d, The box and sieve, as applied to the scatterer, for the purpose of separating the seeds of weeds from the grain. 3d, The method of raising and lowering the scatterer, by means of the screw, or its equivalent."

70. For an *Improvement in Water Proofing Cloth, &c.;* M. J. Lieberman, subject of the Emperor of Russia, at present residing in the City of New York, Assignor to G. S., S. H., and J. E. Hanford, City of New York.

Claim.—"I claim the process of preparing oiled muslin, or other similar fabrics, by means of oils, sugar of lead, and a stove room or drying oven."

71. For an *Improvement in Casting Spouts of Tea Pots;* Henry Tiebe and William Muhle, Assignors to themselves and H. H. Homan, Cincinnati, Ohio.

Claim.—"We claim confining the congelation of the metal or 'stock' in casting, to

an exact joining edge or margin, by applying a part of the mould at a heat above the fusing of the said stock, whether used for forming the base of the tea pot spouts, or otherwise."

72. For an *Improvement in Trussing Yards to Vessels' Masts;* Joseph Perkins, Assignor to self and H. P. Upton, Salem, Massachusetts.

Claim.—"I claim placing the centre of the fore and aft movements of vesssel's yards nearer to the yards than to the masts, when the so placing of its centre of movements is combined with the extension of the rocker bolt or spindle through the projector or gallows brace, into a fixed bearing upon the mast."

MECHANICS, PHYSICS, AND CHEMISTRY.

*On an Improved Water-Metre.**

The rapid growth of water-works, in this and other civilized countries, extending to towns of second and third rate importance, has rendered the production of an efficient water-metre a matter of considerable practical interest.

A good water-metre, besides its application to the purpose of waterworks, will be found a useful auxiliary to brewers, distillers, and liquid merchants generally; also, to engineers and to all engine proprietors; by furnishing a register of the water pumped into steam-boilers; from which a correct estimate may be found of the evaporative powers of the boiler, and the relative quantity of the fuel employed, independently of the working conditions of the engine.

The metre is required to fulfil the following conditions:

1. It must register correctly the quantity of water passed through the metre, either at high or low speeds.
2. It must not be affected by the pressure of a high column of water upon its working parts.
3. It must allow the water to pass through without obstructing or at intervals checking the same.
4. Its working parts must be protected against the effects of mechanical impurities or corrosive agencies in the water, so as to insure it continuous working without frequent attention.
5. It must be a cheap and compact instrument, adapting itself conveniently and locally to ordinary circumstances.
6. Its working and registering parts must be inaccessible to the employer, in order to prevent fraud.

The fulfilment of these conditions might at first sight appear an easy problem for a skilled mechanician, but the numerous and fruitless attempts that have been made at its solution have proved the real difficulty of the task. In order to combat these difficulties successfully, it is necessary to discriminate between those that are inseparably connected with certain principles of action, and those of mere detail of arrangements, or choice of material. All metres that have hitherto been proposed may be classed under the four following heads, viz:—1. Cistern or bucketmetres. 2. Piston-metres. 3. Metres by area of channel. 4. Metres by impact.

* From the Repertory of Patent Inventions, Sept., 1854.

Mr. Mead, of London, proposed a registering bucket-metre, of very simple construction, consisting of a mould or double bucket, divided equally by a cross partition and carried by a rocking shaft. Perpendicularly above this rocking shaft is the open mouth of the supply-pipe, for filling alternately the one and the other bucket. At the extremities of the buckets, small pockets are provided, that fill at the instant their respective buckets overflow, and being at the greatest distance from the rocking shaft, cause the filled bucket to overbalance the empty one, and discharge itself into the cistern below. The supply of water is regulated by means of a float and a cock. The rocking shaft gives motion to a counting apparatus by means of a ratchet and wheel.

Mr. Parkenson, of London, invented a bucket-metre, pertaining to its construction to the ordinary gas-metre, which is found to register the water passing through with great accuracy, and is actually used to a great extent in connexion with receiving cisterns.

The disadvantage of these metres is that they destroy the onward pressure of the water, and are, of necessity, encumbered by cisterns at elevations above the premises supplied.

The name "piston-metre" is intended to comprise all metres in which the fluid is measured by displacing a piston, a disk, or a diaphragm, and thereby filling a measured cavity.

The piston-metre in this respect resembles the bucket-metre, with the advantage of transmitting the onward pressure of the water, and of dispensing with the necessity of a cistern. On the other hand, it labors under great and peculiar disadvantages, partly on account of the valves and pistons which are employed being quickly destroyed by the sand and other impurities contained in the water, or broken by its impact against them, and partly on account of their great bulk and expense in proportion to the water measured.

It will only be neccesary to mention a few of the multitude of piston-metres that have been proposed, for the sake of illustration. Those of Lewis, and Taylor, both of Manchester, and of Messrs. Barr & Macnal, of Paisley, are examples of single cylinder-metres, with tumbler arrangements, to reverse the valves suddenly, in order not to check sensibly the column of water moving through the pipes. Captain Ericsson, of America, and Mr. Chrimes, of Rotherham, simultaneously proposed a metre, consisting of two cylinders working on cranks at right angles to one another, in order to equalize the flow through the pipes, and to be able to apply slide valves, worked by eccentrics, in place of the more complicated tumbler arrangements. Mr. Roberts, of Manchester, constructed, in 1851, a cylinder-metre, made to tumble or oscillate by the weight of the piston. Messrs. Bryan, Donkin, & Co., of London, invented, in 1850, a disk-metre: Mr. Parkenson, of Bury, and Messrs. Chadwick & Hanson, of Salford, have substituted india-rubber diaphragms for the piston, and the disk, respectively. Mr. Adamson, of Leeds, made a metre resembling the rotary engine, in which direction he has been followed by several others.

The last named metre is the only one of this class that has been practically used for several years (at Leeds), but it was finally superseded, on account of excessive wear and tear, and frequent stoppages.

A metre "by area of flow" presupposes a constancy of pressure, and knowledge of the time of continuation of flow. It is practically resorted to for measuring, approximately, large volumes of water, by passing it over an overflow, and taking into account the depth of water column, its breadth, and the time of flowing.

The great inconvenience of this system is illustrated by the fact that many houses in Paris require upwards of ten cisterns for the supply of the different inmates. Besides which, it is unjust, for it obliges every consumer to pay at a maximum rate.

Several years since (in 1845), the writer of the present paper invented a metre which measured by area of channel, and dispensed with the necessity of a cistern; registering the quantity of water actually passed through. It consisted of a square pipe, containing a common flat valve, which the water had to raise in order to pass through. The spindle of this valve passed through a stuffing box, and carried a lever which by its motion raised or lowered a driving strap upon two reversed cones. The cone, with its apex pointing downwards, received a regular motion by means of clock-work, while the reverse cone communicated motion received through a strap to a counting apparatus. When no water passed through, the flat valve was closed, and the clock-work stopped by means of a detent. The instant, however, the valve was raised by the passage of water, the clock-work was released, and a very slow motion was imparted to the counting apparatus; and in proportion as the flow increased, the strap was raised and the motion of the counting apparatus increased.

A metre differing only in its details from the above, has recently been brought out by Mr. Kennedy, of Kilmarnock.

The frequent necessity for winding up the clock movement rendered this metre unfit for general application. To obviate this, the writer thought of abstracting the motive power for the clock from the water itself, by introducing a screw propeller into the pipe.

Being advanced thus far, it became apparent that the valve and clock-work might be entirely dispensed with, if the propeller could be made to rotate in the precise ratio of the moving column of water, and to impart that motion directly to the counter.

Thus, the first step was made toward the production of a metre by impact, by which it is contended the conditions above enumerated of a perfect metre are most fully realized.

The writer considers it an essential condition of an impact metre, that the propelled vanes merely glide edgeways through the water, by partaking fully of its onward motion, without sensibly impeding or agitating the same.

These conditions are most fully complied with by a perfect screw suspended on two pivots, in the axis of the moving column of water. They are also fulfilled by a Barker's mill, or turbine of spiral blades, that yield to the motion of the water outward from a centre.

The correctness of the author's supposition was proved indirectly by the failure of an attempt made at about the period referred to, by Mr. Abraham, to register the water flowing through a pipe by means of a

screw propeller of irregular form, although suspended with great care between points of agate.

The same unsatisfactory result was obtained some years later by Mr. Tebay, of London, who formed his propeller by making radial incisions into a disk of brass plate, mounted upon a spindle, and by twisting each segment in the same manner, like the vanes of a windmill. He endeavored to counteract the inaccuracy of his propeller by introducing valves so contrived that the water should be able to pass only at a fixed velocity.

In order to obtain correct measurement by an impact metre, it is not sufficient that the propeller should yield equally in all its parts to the motion of the water, but it must also possess the power to overcome a uniform resistance by friction in its bearings, &c., without diminishing its proportionate rate of rotation at low speeds.

The apprehension of these difficulties deterred the writer, for several years, from proceeding, until the pressing want for a metre, to carry out some other improvements, induced him to construct, in 1850, the metre exhibited to the meeting; which metre, in point of accuracy of measurement and compactness, fully satisfied a committee of inquiry of the Manchester Corporation Water Works, by whom its adoption was recommended. The successful results obtained by this metre, which the writer had not even an opportunity to adjust previous to its official trial, were thought strong proofs in favor of the principle involved. He was indebted for the first execution of his idea, and some valuable suggestions, to his brothers at Berlin.

In attempting, however, to put the metre into regular service, under a working pressure of upwards of 200 feet column of water, subject to violent concussions, and acted upon by mechanical as well as chemical impurities in the water, he, and the manufacturers, Messrs. Guest & Chrimas, of Rotherham, had to encounter many serious difficulties, which finally determined them to adopt, for smaller metres, the more simple arrangement of a spiral curve, or Barker's mill.

One arrangement now adopted consists of an apparatus having a double screw or balance-metre capable of measuring 100,000 gallons per hour, or above two million gallons per day.

This metre is provided with a cylindrical casing, lined throughout with a brass tube, drawn to a precise gauge, and connected by its flanches to a line of piping of 8 or 9 inches in diameter.

The measuring apparatus contained in this casing consists of two hollow drums, which carry, on their circumference, the one a set of right-handed and the other a set of left-handed screw-blades. Conical blocks, armed with radial projections or guide-blades, are fixed at each end of the apparatus, extending nearly to the two screw drums, which are caused to rotate by means of bevel wheels. Two double inverted cones are provided, one at each end of the casing, for the purpose of directing the water towards the centre thereof.

The main spindle, carrying the upper bevel wheel, passes, through the hollow arm of a central bracket, into a close chamber, and carries an endless screw, which drives the counting apparatus.

The water enters the metre through a grating, which is provided to arrest large solid bodies that might obstruct the working of the apparatus.

The inverted cone at the inlet end of the metre, directs the current of water toward the centre, where it again spreads over the conical block, and, being directed parallel to the axis between the guide vanes, impinges obliquely upon the right-handed vanes of the hollow screw drum. The object of (figuratively speaking) kneading the current of water between the conical surfaces is, to destroy partial currents within the same; and in spreading it from the axis, to increase its leverage on the rotating drum. The diameter of the body of the drum is made slightly smaller than the diameter of the conical block, in order to protect the former from endway pressure of the moving column of water. Some clearance is allowed between the helical vanes and the surrounding casing; but the passage of water outside the vanes is effectually prevented by slight contractions of the water-way at both ends. In order to prevent wear and friction on the bearings, the body of the revolving drum is made hollow to such an extent, that the water displaced nearly balances the weight of metal. A screw drum of this description moves with a very gentle current of water, but it would, nevertheless, make a very imperfect metre if it were simply connected to the counter, inasmuch as the friction in the bearings and of the counter would retard it most at low speeds, and the friction of the vanes in gliding through the water (which increases in the ratio of the square of the velocity) would again greatly retard it at high speeds,—the maximum rate of measurement being obtained at a medium speed.

By the addition of the second or left-handed drum, these variations in speed are compensated. For the sake of illustration, let it be imagined, that both screw drums revolve independently of each other (of course in opposite directions), and that the second or left-handed one alone imparts its motion to the dial; let it also be supposed that the friction of both drums is the same;—the water, in meeting the oblique vanes of the first drum in a direction parallel to the axis, will be deflected from its straight course proportionally to the resistance to rotation of the drum, say an angle of 1°. Pursuing its fresh course, it will strike the left-handed screw blades of the registering drum, in an angle at 1° more obtuse than the previous; and, being deflected by the resistance offered through 1° in the opposite direction, the water will pass out in a direction parallel to the axis, and, consequently, a true rate of measurement will be obtained. By coupling both drums rigidly together by bevel gearing, a great practical advantage is obtained, namely, that of one drum assisting powerfully to overcome an obstruction offered to the other. Let it be imagined, for instance, that a pebble or piece of vegetable matter has wedged itself between the casing and tip of the vane of the first drum, so as to stop it entirely, and to force the column of water passing through into the helical course; the water would then impinge upon the left-handed vanes of the second drum rectangularly (supposing the inclination of the reverse vanes to be at an angle of 45° to the axis), and expend its entire momentum upon it; the effect of which would be added to the impact on the first drum through the bevel gearing, to overcome the obstruction. The motion is conveyed to the counter by the upper bevel wheel; but the lower wheel is added to strengthen the connexion between the two drums, and to relieve all the spindles from pressure. Before leaving the metre, the current of water

is again contracted between conical surfaces, for the same purpose as before, namely, to equalize its flow.

In calculating the quantity of water that will effect one complete revolution of the screw-drums, it is necessary to compute the clear net area between them and the external casing,—supposing all the surfaces to be covered with a film of stationary water (by adhesion), $\frac{1}{140}$th part of an inch in thickness, and to multiply the same by the pitch of the screw. The correction for adhesion amounts to an inappreciable quantity for large metres, but constitutes a considerable per centage in the calculation for small metres.

The difficulties that have been encountered in the manufacture of this metre apply principally to the spindles. Although relieved from all constant pressure, they have nevertheless to maintain the drums in their central position, and to resist a strain endways, caused by the mere friction of the water in passing along the vanes;—they have, in consequence, to be made of hard metal. A hard bronze was found to be the most suitable metal, and answers well for metres of large size; but it is difficult to produce the spindles for small metres of that metal.

The difficulty at first experienced of producing screw-drums of correct shape and uniform size, without incurring a large amount of workmanship, was successfully removed by casting them, and many other parts, in metallic moulds. The manufacturers also tried gutta-percha, which, being slightly lighter than water, was, with its spindle, exactly equal to the weight of water which it displaced; but it could not be made sufficiently correct and rigid in the vanes. After some time, the manufacturers succeeded in casting drums for the larger metres of bronze, and in dry sand, with great accuracy.

The calcareous matter in water deposits only on the surfaces of brass that are not exposed to the current. It exercises, therefore, no effect on the measuring surface, but if allowed to penetrate into the chamber of the counting apparatus, it incrusts the small wheels and spindles, and causes them to break or wear rapidly. To alleviate this, a lower division of the box containing the counting apparatus, is filled, before it leaves the manufactory, with pure olive oil, which affords a complete and continuous protection to the wheels.

For metres having a supply pipe of less than two inches diameter, the spiral form of propeller, or Barker's mill arrangement, is adapted; except in cases where the water acts impulsively, as, for instance, in supplying steam-boilers by means of pumps,—where the double screw metre is the only one applicable.

In the second arrangement of the metre before alluded to, the water enters through a side pipe, and traversing a cylindrical grating, covered with wire gauze, it passes downward through a central funnel, into the propeller; and issuing from two apertures of its circumference, it passes into a chamber leading to the exit pipe.

At the bottom of the propeller a chamber is formed filled with oil through small apertures at the bottom, and sealed close, leaving only an eye in the centre, through which an upright stud of bronze enters, which, with its steel point, abuts against a steel plate in the bottom of the propeller. The lower chamber of the counting apparatus box is formed of

white metal, cast in one piece with the wire gauze grating, and it is filled completely with oil.

Theoretically speaking, this metre is less perfect than the compensating screw-metre, but it possesses the great advantage of containing only a single bearing that is at all liable to wear, and that bearing is effectually protected from the action of the water. The practical effects of this simplification of parts has been, that, of 150 metres of this description that are at work, not one has as yet been returned disabled or inaccurate.

Mr. Adamson, of Leeds, has lately projected a metre with two sets of spiral blades, upon the principle of a turbine; the inner set being stationary, and the outer set revolving. This metre also gives a very good result.

Another kind of a metre lately brought out by Mr. Taylor, of Manchester, having a revolving horizontal drum or water-wheel, acts partly by jet and partly by impact; but on this account it appears to the writer imperfect in principle.

It has been argued before that no accurate measurement can be effected by the application of jets. To avoid them in the spiral metre, it is essential to make the area of the outlet larger than the area of the supply-pipe. Nevertheless, the nature of a jet still manifests itself to some extent by increasing the rate of the metre at high velocities. This defect has, however, been effectually counteracted by the application of rotating flies or drag-boards fixed to the outer edge of the propeller, which offer a resistance increasing as the square of the velocity, and can be regulated to equal the effect obtained by the jet. They offer also great facility in adjusting the absolute measurement of the metre.

In order to insure the efficiency of each metre, it is necessary to test the same under variable pressures, and with considerable volumes of water. To this point the manufacturers, Messrs. Guest & Chrimes, have devoted great attention. The apparatus they employ consists of a large cistern, 40 feet high, and a second cistern below, capable of containing 1000 gallons, and accurately graduated throughout. A set of pipes which have been proved to transmit given quantities of water per minute, under the pressure from the upper cistern, is provided, and from 8 to 12 metres to be tested are coupled in a line, one behind another, to a pipe leading from the upper cistern to the outlet of the metres. The test pipes are then alternately connected; a uniform quantity of water, as shown in the cistern, is passed through each pipe, and the number of gallons indicated on the different counters is noted in a book opposite to the permanent number of the respective metres. An extract from this book shows how nearly correct a measurement is obtained.—*Inst. Mech. Eng., Birmingham.*

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*A Monster Fly-Wheel.**

Mr. Clay described the large fly-wheel at the Mersey Forge, which was stated to be the largest in the world. In the rolling boiler plates there is a certain limit to the speed at which the roller should travel—in

* From the Lond. Civ. Eng. and Arch's. Jour. November, 1854.

other words, the number of revolutions made by the roller are very few when compared with the rollers of other descriptions of iron; and it was therefore necessary in a mill where direct action was required, that a fly-wheel should be constructed of sufficient size and weight to have, with a small number of revolutions, sufficient momentum to overcome the ordinary shocks of rolling large plates of iron. This could only be done by increasing the diameter of the wheel to such an extent that the rim should have the requisite momentum. With this view a wheel has been made of 35 feet diameter, and weighing about 60 tons, about 24 tons of which is disposed in the rim, which is intended to run with a velocity of about 4500 feet per minute, in making about 38 revolutions. Great care was necessary, in a wheel of such magnitude, that the various parts should be well and securely fastened together, and after finishing the drawing of the wheel it was submitted to the authority of Mr. Fairbairn, who pronounced it as perfectly safe at a velocity of 14,000 feet per minute—number of revolutions, 120.

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*On the Flow of Gas Through Pipes.**†

(Continued from page 47.)

The next experiments which we shall examine comprise a series of six given by Mr. Clegg in his work on Gas-Lighting.

Table showing the Quantity of Gas of Specific Gravity ·420 discharged per hour, according to Mr. Clegg's Experiments, from a 6-inch main, with a pressure equal to half an inch of water.

Length of pipe, in yards.	Quantity discharged per hour, in cubic feet.	Value of x Calculated from the Equation $x=\frac{Q\sqrt{Lg}}{D^2\sqrt{H}}$
3·46	44280	2100
4·5	38838	2100
7·5	30000	2096
16·5	20270	2099
25·	16460	2099
34·2	14080	2100
		6) 12,594
The coefficient derived from Mr. Clegg's experiments on a 6-inch main		2099

Mr. Clegg gives a single experiment with a 4-inch main, in which he found with a pressure equal to 3 inches, 852 cubic feet of gas of specific

* *Hughes' Treatise on Gas Works.* London: J. Weale.

† From the London Artizan, April, 1854.

gravity ·398 were delivered from a main 10,560 yards in length. The coefficient derived from this experiment is

$$\frac{852 \times \sqrt{10560 \times \cdot 398}}{16 \times \sqrt{3}} = 1993.$$

Most of the following experiments are taken from a paper by Mr. Pole. In the last column, the value of the coefficient x has been calculated as before; and in order to present a clear view of the way in which this coefficient varies with the diameter of the main, the result of the previous experiments are repeated in the table.

No.	Diameter of pipe, in inches.	Length of pipe, in yards.	Pressure, in inches of water.	Specific gravity of gas, air being 1.	Quantity discharged in cubic feet per hour.	Value of x calculated from Equation $x=\frac{Q\sqrt{Lg}}{D\sqrt{H}}$
1	0·5	10	1·25	·4	120	860
2	0·5	59	1·25	·4	60	1043
3	0·62	41	1·34	·559	99	1065
4	0·62	62	1·34	·559	83	1096
5	0·62	93	1·34	·559	74	1198
6	0·62	119	1·34	·559	57	1045
7	0·62	138	1·34	·559	53	1047
8	2·00	25	0·5	·528	1630	2094
9	4·00	10560	3·0	·398	852	1993
10	6·00	3·46	0·5	·42	44280	2100
11	6·00	4·5	0·5	·42	38838	2100
12	6·00	7·5	0·5	·42	30000	2096
13	6·00	16·5	0·5	·42	20270	2099
14	6·00	25·	0·5	·42	16460	2099
15	6·00	34·2	0·5	·42	14080	2100
16	8·00	1842	0·7	·4	6000	3042
17	10·00	100	3·00	·4	120000	4382
18	10·00	1760	3·00	·4	30000	4596
19	18·00	1760	1·00	·4	66000	5405
20	26·00	3130	·8	·42	103000	6173
21	26·00	4300	2·25	·42	17500	6990
22	26·00	4300	0·475	·42	80000	7255

Returning, now, to formula (4,) according to which Mr. Clegg's tables are calculated, on the supposition that x is equal to 2096, we shall find on examining the above table, that this coefficient will not correspond with any of the experiments made on pipes of less diameter than 2 inches or greater than 6 inches. For instance, the formula used by Mr. Clegg would give more than double the true quantity delivered when applied to a pipe half an inch in diameter, and when applied to a main of 26 inches, would give a result less than one-third of the true discharge from this main. To make this more clear, let us suppose it be required to calculate the delivery of gas according to the experiments above cited. For a half-inch pipe we have two experiments, one of which gives a coefficient of 860 and the other 1043, the mean of which is 952. Mr. Clegg's coefficient, we have already seen, is 2096, and the coefficients derived from experiments on a 26-inch main are 6173, 6990, and 7255,

the mean of which is 6806. Hence, if we were to establish a rule for finding a quantity of gas delivered,

According to experiments on the $\frac{1}{2}$-inch pipe, the formula would be

$$925\ D^2\sqrt{\frac{H}{Lg}}$$

According to Mr. Clegg's experiments, it would be

$$2096\ D^2\sqrt{\frac{H}{Lg}}$$

According to experiments on the 26-inch main, it would be

$$6806\ D^2\sqrt{\frac{H}{Lg}}$$

In examining these apparently irreconcileable results, the principal feature which immediately strikes us is, that the friction of the gas in passing through the pipes is not represented or taken into account in any of the formulæ. Now, it appears, that comparing the two coefficients 952 and 6806, one of which is seven times greater than the other, that a 26 inch pipe will deliver seven times the quantity due to its area as compared with a half-inch pipe. This is very nearly in the proportion of the square roots of the diameters, for

$$952 : 6806 : : \sqrt{\cdot 5} : 5\cdot 055.$$

The root of 26 being 5·099, this ought to be the fourth term in the above proportion; but, considering all the circumstances of the case, the correspondence is tolerably near.

It would be wearisome to go through a similar comparison with all the other experiments. It may suffice to say, that no other form of expression agrees so well with the experiments as that in which the quantities delivered are further increased as the square roots of the diameters.

I therefore propose a formula in which the square root of the diameter shall be used as a multiplier, and will add a table showing the results of all the preceding experiments when compared with the quantities calculated in this way.

It will be advisable to take the experiments on the 26-inch main as the most trustworthy; and here, as we are going to introduce a new multiplier equal to 5·099, the square root of the diameter, we must of course divide the coefficient 6806 by 5·099, in order to find the new coefficient.

Hence, $\frac{6806}{5\cdot 099}=1335$, the new coefficient required. The general formula, then, which I shall propose for calculating the quantities of gas delivered through pipes, in the present state of our knowledge, is

$$1335\ D^2\sqrt{\frac{HD}{Lg}} \quad . \ . \ . \ . \ . \quad (6)$$

Table showing the Quantities of Gas delivered by Experiment and Theory in the following series of Experiments, which are numbered to correspond with those in the Table on page 122.

No.	Quantity by experiment.	Quantity by calculation.	No.	Quantity by experiment.	Quantity by calculation.
1	120	132	12	30000	46862
2	60	54	13	20270	31527
3	99	97	14	16460	25424
4	83	80	15	14080	22011
5	74	65	16	6000	7433
6	57	57	17	120000	115611
7	53	53	18	30000	27554
8	1630	1481	19	66000	69206
9	852	1130	20	103000	113710
10	44280	68726	21	175000	162443
11	38838	60556	22	80000	74453

In this comparison of theoretical quantities with actual discharges, it will be seen that considerable differences exist. With the exception of experiments 9 to 15, however, the differences are perhaps not more than might be expected when the numerous distributing causes are taken into account. In the first place, the mains may not have been strictly horizontal, although assumed to have been so by the authors of the experiments. Secondly, there may have been bends or angles in the course of the main, as in the case of experiment No. 9, which is recorded in Mr. Clegg's Treatise on Gas Lighting, and was made on a pipe nearly six miles in length, the discharging extremity being brought round in a large circle nearly to the place where the gas first entered the pipe. In this experiment it will be observed, the theoretical quantity is more than 30 per cent. in excess of the actual discharge.

By far the greatest variation, however, is found in Mr. Clegg's experiments on 6-inch pipes (experiment 10 to 15,) where the results by theory are about 50 per cent. more than by experiment. I am unable to account for this variation, which does not exist to any thing like the same extent in any of the other experiments.

The extreme shortness of the lengths of main employed by Mr. Clegg, may have exercised some influence by admitting atmospheric air to resist the flow of the gas.

For those, however, who are disposed to place confidence in Mr. Clegg's experiments, to the exclusion of others, it will be readily competent to derive a coefficient from Mr. Clegg's experiments, by dividing the number in the last column of table at page 122 by 2·449, the square root of 6.

The tabular number in Mr. Clegg's experiments being 2099, we have $\frac{2099}{2{\cdot}449}=857$, the coefficient to be used according to Mr. Clegg's experiments.

The conclusion to be drawn from a review of all the experiments which

have been made on the flow of gas through horizontal pipes is this, that taking friction and every thing else into consideration, the quantity is equal to x A, where

$$A = D^2 \sqrt{\frac{HD}{Lg}},$$

and where x is the coefficient to be determined by experiment.

Let Q be the quantity determined by experiment, then we have

$$x = \frac{Q\sqrt{Lg}}{D_2\sqrt{DH}}$$

Those who desire a more exact method of determining the quantities of gas which will be discharged through pipes of various diameters, must be content to wait for the determination of x by means of an extensive and accurate series of experiments, which, by giving the quantity of gas having a known density discharged through mains of certain length and diameter under a known pressure, will afford the means of calculating the value of x, or the coefficient to be used in all other determinations.

I think it right to remark, that in Mr. Pole's very admirable paper * from which I have quoted some of the preceding experiments, the author arrives by an entirely different method at a formula very nearly identical with that which I have given.

The formula which Mr. Pole proposes for gas is

$$1350\ D^2 \sqrt{\frac{HD}{Lg}},$$

the only difference being that his coefficient is 1350 instead of 1335. Mr. Pole adds in a note, that in some recent experiments on a 9-inch main giving the discharge under various pressures, the results would require his coefficient to be reduced to 1150; but goes on to say that it would not be judicious to adopt such an alteration for general use, unless confirmed by other experiments on pipes of different diameters.

We now come to the third division of the subject, namely, where mains are laid with an inclination above or below the point of supply. We have here again to regret the insufficiency, or rather the entire absence, of such experiments as would elucidate the inquiry. The rule which appears to be generally adopted is this, that every variation in the inclination of the main causes a corresponding difference of pressure at the rate of one-hundredth of an inch for every foot of rise or fall. Thus, when a main rises 10 feet above a datum line at which the pressure is known, an increase of pressure is obtained equal to one-tenth of an inch; and, on the other hand, when a main is at any point 10 feet below such a datum line, the pressure is diminished to the extent of one-tenth of an inch.

* Published in the *Journal of Gas Lighting*, for June, 1852.

For the Journal of the Franklin Institute

Steam Navy of the United States.

At a time like the present, when the United States may, at a moment's notice, be brought in contact with some of the naval powers of Europe, we may, with propriety, examine into that branch of our Navy, upon which we must rely in case of such collision. Any fleet that ventures into action without the aid and assistance of steamers, which shall form a part of it, and a large part, too, will only do so to be defeated, for the ability to take position has always been considered an element of success. There has been such an objection to any increase of the Navy for several years past, that Congress has preferred to spend millions in repairing worn-out hulls of sloops, frigates, and ships of the line, rather than to build steam vessels suited to the wants of the service, and thus, old vessels, whose defect in model alone should have condemned them long ago, have been repaired at a cost equal to that of their original construction; a system of practice, not to be commended for its economy or durability. The present Secretary of the Navy, Mr. Dobbin, has succeeded in satisfying the Congressional Committees on this subject, and a feeling, more in unison with the interests of the Navy, is becoming prevalent in both Houses of Congress, and if his views are carried out, he will leave his department, when he retires from it, in a condition that will reflect credit on his administration.

Of steamers, that are already built and in service, we have as follows:

The	Mississippi,	side wheel,	1788	tons,	10	guns.
"	Susquehanna,	" "	2436	"	10	"
"	Powhattan,	" "	2419	"	10	"
"	Saranac,	" "	1426	"	8	"
"	San Jacinto,	Propeller,	1426	"	8	"
"	Princeton,	"			8	"
"	Fulton,	side wheel,			5	"
"	Michigan,	" "			1	"

In addition to the above, we have a few small craft that might possibly be of use on coast duty, but are unfit for foreign service.

Congress, at its last Session, authorized the construction of six first class war steamers; and at a board of officers, held at Washington, it was decided that they should be sailing ships *with auxiliary screw power;* that the propeller should have two blades, and be arranged so as to hoist out of water when the vessel was under canvas. Immediately after this decision, Mr. Martin, Engineer-in-Chief of the Navy, was sent over to Europe to examine into the merits of the several forms of screw machinery, and particularly into the different methods of disconnecting and hoisting the screw. On his return, a board of officers was convened at Washington, consisting of Mr. Lenthall, Chief of the Bureau of Construction; Mr. Martin, Engineer-in-Chief; Messrs. Wood, Hunt, and Everett, Chief Engineers; and Mr. Copeland, Consulting Engineer to the Navy. Previous to their meeting, plans and proposals had been asked for machinery, and it was with particular reference to this business, that the board was convened. As these vessels have two gun decks, and a capacity to carry fifty 8 and 10 inch guns, it became necessary to exercise

much caution, so that a proper capacity should be allowed to each department. Thus, 50 guns involve a certain number of men; the number of men regulates the quantity of water, provisions, etc.; all these calculations were made by Mr. Lenthall, and the utmost space that could be allowed to the machinery and coal, was 60 feet in length by the width of the ship under the lower deck, which was 17 feet from face of timbers. The Board decided upon giving to each vessel two direct action engines, with horizontal cylinders, each having an effective diameter of 72 inches and a stroke of 3 feet, connecting at right angles to one shaft, having cranks forged on. Four boilers, having in all a grate surface of 320 square feet, and a heating surface of 11,500 square feet. Propellers to be 17 feet 4 inches diameter, and with 2 blades, 23 feet pitch. The plans and propositions of the following parties were accepted, and contracts made with them for the machinery, to be made from their own designs, the same being warranted by them for six months after the trial trip.

Anderson, Delany & Co., of Richmond, Va., build the machinery for the *Roanoke* and *Colorado*, at Norfolk; Merrick & Sons, of Philadelphia, for the *Wabash*, at Philadelphia; Robert P. Parrott, (West Point Foundry,) for the *Merrimac*, at Boston. The machinery for the *Minnesota*, at Washington, is to be built at the Government shops, in the Navy Yard at that place, from designs prepared by Mr. Martin, Engineer-in-Chief. The *Roanoke*, *Colorado*, and *Minnesota*, will have trunk engines, in general design, similar to those of Penn & Son, of Greenwich. The *Wabash* will have engines somewhat similar to those of the French steamer *Pomone*. The *Merrimac* will have engines with two piston rods to each cylinder, similar to those of the English steamer *Amphion*.

The boilers of all the vessels are alike, and have plain arches below, returning between vertical tubes above; these tubes are 3 feet 3 inches long, 2 inches outside diameter, and of brass; each boiler has about 1500 tubes, and the construction is such, that any tube proving defective, it may be removed without disturbing the others; this form of boiler, originated with Mr. Martin, Engineer-in-Chief, and has been secured to him by patent. As to its merits, it is only necessary to say, that while every contractor was at liberty to adopt any form of boiler containing the amount of fire and grate surface required, yet, all have adopted this from choice.

The following are the principal dimensions of these vessels:

Length between perpendiculars,	265 feet 8 inches.
" from knight-head to taffrail,	287 " 7 "
Beam, moulded,	50 " 2 "
" outside of plank,	51 " 4 "
Depth of hold to gun deck,	26 " 2 "
" " " spar deck,	32 " 7 "
Tonnage,	3200 tons.

They are being built in the most substantial manner, having a live oak frame diagonally plated with iron inside, and white oak keel, keelsons, and plank. Much activity is being used in their construction, and all of them will, no doubt, be launched by the first of October next, and in commission in four months from that date, that being the time required by the contractors after the launching of the vessels.

Having described the above five ships, the models of which were furnished by Mr. Lenthall, I will now turn to the *Niagara*, which, differing

in very many respects from the others, requires special notice. The hull of this vessel is being constructed from the designs and under the immediate supervision of Mr. George Steers, known as the builder of the yacht *America*. Mr. S. has been appointed a Naval Constructor for that purpose. She is building at the Brooklyn Navy Yard, and has the following principal dimensions:

Length over all,	345 feet.
" on load line,	333 "
Beam outside of plank,	55 "
Depth of hold to spar deck,	31 "
Tonnage,	4800 tons.

This vessel is to have but one gun-deck, and will carry 12 guns of the largest size. This reduction of armament, combined with her increased size, allows of a material increase of the space allotted for machinery, and the Board decided to put in 3 direct action horizontal engines, having cylinders of 72 inches diameter, and 3 feet stroke, all of them being connected to one shaft, having the cranks forged on it at an angle of 120° with each other. Boilers, to be 4 in number, and to contain 430 square feet of grate surface, combined with 18,000 square feet of heating surface.

Having been thus particular in giving the dimensions of these vessels, I wish now to make some remarks in relation to their speed. The first five ships are almost identical in form, although there is a slight difference in their model; if we compare them with the Collins' line of steamers, which are 400 tons smaller, we find that these vessels have less than $\frac{5}{8}$ths the power of the steamers of that line, and this gives us a starting point from which to ascertain the speed. The average summer passages of the Collins' line give a speed of $12\frac{1}{2}$ knots per hour. Now, the midship section of those ships is about 913 square feet, while of these, it will be 1129 square feet; therefore, if the models were equally good, these vessels would require $\frac{1}{8}$th more power than the Collins' line to equal them in speed, but as such is not the case, and their power is limited to less than $\frac{5}{8}$ths the amount belonging to those steamers, it will be found, on calculating the several points of difference that if the models were equal, the speed due to these ships would be $9\frac{3}{4}$ knots at the time the others make $12\frac{1}{2}$ knots. This $9\frac{3}{4}$ knots will be reduced by the fact that these vessels have very full models compared with the Collins' ships, and that their propelling power is a screw, instead of the side wheel, the latter being unfit for war steamers; so that, making fair allowances for these differences, 8 knots in fair weather, may be assumed as the speed due to these steamers.

The *Niagara*, in model, is equal, if not superior, to the Collins' line. Supposing her equal, and making no deduction for difference of effect between side wheels and propeller, her speed should be $11\frac{1}{3}$ to their $12\frac{1}{2}$ knots. It will be observed, that I have not alluded to *trial trip* speeds, or *fair wind* passages; but to regular speeds under steam, in fair weather at sea.

In addition to these vessels, the Department are building at Portsmouth, N. H., in place of the line of battle ship *Franklin*, condemned, a large screw steamer of 50 guns, but no progress has been made in her machinery.

There is also building, by Mr. Stevens, at Hoboken, opposite New York, a floating battery of iron of large size. This affair has been many years in slow progress, and the time of its completion is yet far distant.

In addition to all the vessels, to which I have alluded, the Secretary of the Navy proposes to build 6 screw steamers of about 1500 tons. This matter is before Congress, and appropriations for their construction will, no doubt, be made the present Session.

Supposing this to be done, we shall then have, including the floating battery, 22 steamers, a number, which, while it will not compare with the navies of England or France, still, will make a respectable show, and would, no doubt, be heard from in any naval action in which they took a part. B.

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*Electro-Magnetic Engraving Machine.**

This machine is somewhat on the principle of the well known planing machine. The drawing to be copied and the plate to be engraved are placed side by side, on the movable table or lid of the machine; a pointer or feeler is so connected, by means of a horizontal bar, with a graver, that when the bar is moved, the drawing to be copied passes under the feeler, and the plate to be engraved passes in a corresponding manner under the graver. It is obvious that in this condition of things, a continuous line would be cut on the plate, and, a lateral motion being given to the bed, a series of such lines would be cut parallel to and touching each other, the feeler of course passing in a corresponding manner over the drawing. If, then, a means could be devised for causing the graver to act only when the point of the feeler passed over a portion of the drawing, it is clear we should get a plate engraved, line for line, with the object to be copied. This is accomplished by placing the graver under the control of two electro-magnets, acting alternately, the one to draw the graver from the plate, the other to press it down on it. The coil enveloping one of these magnets is in connexion with the feeler, which is made of metal. The drawing is made on a metallic or conducting surface, with a rosined ink or some other non-conducting substance. An electric current is then established, so that when the feeler rests on the metallic surface, it passes through the coils of the magnet, and causes it to lift the graver from the plate to be engraved. As soon as the feeler reaches the drawing, and passes over the non-conducting ink, the current of electricity is broken, and the magnet ceases to act, and by a self-acting mechanical arrangement the current is at the same time diverted through the coils of the second magnet, which then acts powerfully and presses the graver down. This operation being repeated until the feeler has passed in parallel lines over the whole of the drawing, a plate is obtained, engraved to a uniform depth, with a fac simile of the drawing. From this a type-metal cast is taken, which, being a reverse in all respects of the engraved plate, is at once fitted for use as a block for surface printing. The machine is the invention of Mr. William Hansen, of Gotha.

Journ. of the Soc. of Arts.

* From the London Athenæum, June, 1854.

Specification of Patent granted to William *and* Joseph Clibran, *for certain improvements in apparatus for regulating or governing the supply or pressure of gas as it is conducted from the main to the burners.*—[Sealed 1st March, 1854.]

This invention consists in a novel construction and arrangement of apparatus for obtaining an even amount of gas whilst passing from the main to the burners for consumption, and consequently, an equality of light, whatever may be the variation of the pressure of the gas. The regulation of the supply from the main to the burners is effected by means of a slide-valve or disk-valve (the slide-valve being preferred), formed by two corresponding surfaces placed together between the branch inlet-pipe from the main and the branch outlet-pipe to the burners. These slide-valves have suitable apertures for the passage of the gas, so arranged that when the apertures are open, the gas will pass freely; but as, by shifting the position of the slide-valve, the apertures may be gradually closed or opened to the full extent, so the quantity of gas allowed to pass from the main to the burners is regulated or governed. The continuous opening and closing of the gas-passages in this slide-valve is effected by the variable pressure of the gas acting within a small gasometer, after the gas has passed the valve; so that as the pressure increases, the gas rising within the gasometer, will cause it to rise, and, by any simple arrangement of connexion or gearing, to open or close the apertures for the flow of the gas, and thus regulate the supply to the burners for combustion.

Fig. 1.

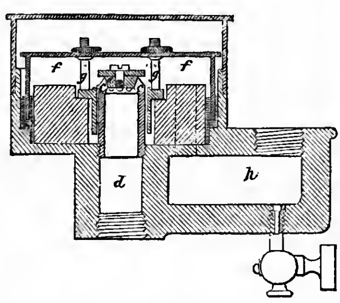


Fig. 2.

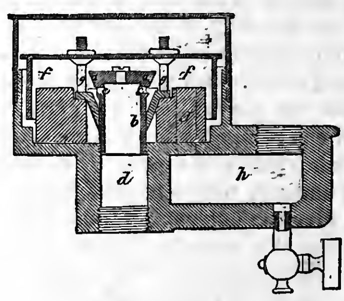


Fig. 1. exhibits a slide-valve of peculiar construction, the upper portion of which *a*, forms the frustrum of a cone. Around this, the collar *b*, fits, and rises and falls; thereby opening and closing the orifices or openings *c*, *c*, *c*, of the frustrum-shaped slide-valve. Fig. 2, represents a similar valve; and the same letters of reference refer to corresponding parts. The action of this improved apparatus is as follows:

The flow of the gas from the main enters through the tube *d*, directly to the centre or interior of the valve, not in its line of direction operating on any one particular portion of the surface of the valve or other mechani-

* From the Repertory of Patent Inventions, Dec. 1854.

cal equivalent, as heretofore has been the case, but in the interior of the valve; distributing an equal pressure on all sides (that is,—radiating from the centre of the said valve). From the interior of the valve the gas passes through the perforations or openings *e*, *e*, *e*, in the direction of the arrows, into the small gasometer or chamber *f*, connected by two small pendants *g*, *g*, with regulating screws at their upper ends, to the collar *b*. The gas from the gasometer *f*, then passes the openings shown by dotted lines at *j*, and, through the pipe *h*, to the burners: in both figures the valves are shown open. Supposing, now, the gas to be at a higher pressure within the valve than desirable to be supplied to the burners, the gasometer *f*, in accordance with its previous adjustment, will raise or elevate the collar or valve *b*, thereby partially closing the outlet space and regulating the equal pressure at the burners: but should the pressure within the valve, and, of course, in the main, become less, then the gasometer *f*, must fall, and the free flow of gas be allowed proportionate to such fall. It will be evident now that, from the peculiar construction of the valve, whatever the pressure of gas in the main, it must be equally diffused over the entire inner surface of the collar *b*, *b*, or of the shutting-off part of the valve; whereby extreme regularity of action is maintained.

The patentees claim, First,—the peculiar construction, employment, and use of an apparatus for regulating or governing the supply of pressure of gas as it is conducted from the main to the burners; having a central slide-valve through which the gas radiates, and thereby causes an equal pressure on all parts of the slide-valve and gas-holder, and also produces the required perpendicular lift of the same, in the manner and for the purposes above particularly set forth and described; such valve being placed in the regulated gas, in contradistinction to the valves of all other known gas-regulators, the valves of which have been invariably placed in the current of the irregulated gas; by which means a valve is obtained which offers no resistance either to the action of the regulating surfaces or to the gas-holder. Secondly,—the peculiar construction or arrangement of an apparatus for governing or regulating the passage of gas, in which the necessary regulation of the gas and the supply of the same for distribution to the burners is effected in one chamber, which causes its operation to be more sensitive to the variations of the pressure in the main, or to the shutting off of the supply of gas to the burners.

For the Journal of the Franklin Institute.

Ventilation of the Fire-Rooms of Steamships. By B. F. Isherwood, Chf. Eng. U. S. N.

The proper ventilation of the fire-rooms of large steamships has become a matter of considerable importance, in view, not only of the comfort and health of firemen, coal-heavers, and engineers, but also of the efficiency of the boilers:—for, unless a rapid and free supply of cold air can be furnished to the furnaces, the consumption of fuel and the consequent production of steam will fall short of what it would be under that condition; and it is rare, indeed, to find a boiler producing the supply desired

even under the most favorable circumstances. But, it is chiefly for the purpose of diminishing the great heat of the fire-rooms of large steamships, which, being situated in the bottom of the hold, are badly supplied with cold air, and the means of rapid exit for the air highly heated by the radiation from the boiler, that free ventilation is of the first consequence. None but those who have stood watches in the confined fire-rooms on the keelsons of our large men-of-war steamships, can appreciate how intolerable is that heat, and how destructive it is to the physical energies and health of those subjected to it:—the heat in the fire-rooms of steamships is what is called "moist heat," and it is much more oppressive and difficult to be endured, than the same degree of temperature of "dry heat."

While considering this subject of ventilation for the fire-rooms of steamships, in the case where the boilers are set athwartships, facing each other, and having the fire-room extending fore and aft the ship between them, as is now the general practice in all the new British steamers whose breadth of beam will admit the arrangement, and, where the smoke chimney is placed over the centre of the fire-room,—it occurred to me, that by placing a pipe inner and concentric with the smoke pipe, open below to the fire-room and above to the atmosphere, as shown in Plate I. Fig. 1, the means would be provided at very little expense of money, materials, or space, for the rapid and free exit of the heated air of the fire-room. For the temperature and height of the surrounding smoke pipe would always cause a powerful ascensional column of air within the inner air pipe, and continuously deplete the fire-room with great rapidity. The supply of cold air should be furnished at the two ends of the fire-room, through a chute or box descending to within three or four feet of the fire-room floor, so as to insure delivery at or about the level of the ash-pits. With this system of ventilation a great decrease of the temperature of the fire-room would be obtained, together with the concomitant advantages of comfort, not only to the engineer force, but to the whole ship, and also a considerable increase in the steam producing power of the boiler.

It is evident, that with the general system, shown in Fig. 1, a telescopic arrangement of chimney, can be had by joining the movable parts of the smoke and air pipes at their upper extremity alone, thus allowing the movable part of each pipe to descend within its corresponding lower or fixed part.

This system of ventilation can also be used in case of boilers extending fore and aft the ship, with the fire-room lying athwartship, when the smoke pipe is placed at the fire-room end of the boiler, as in single return tube and flue boilers, by curving the inner air pipe to an elbow and debouching it horizontally into the fire-room.

At first, it seemed difficult to arrange a damper in a smoke pipe containing an inner pipe; but a little reflection led me to the system of damper, sketched in Figs. 2, 3, and 4. In this system, the damper is divided into two parts, each part movable on its own axis, which axis passes close by the side of the inner pipe.

Fig. 2 shows a cross section of the smoke and air pipes, and a top view of the dampers in a closed position; the black space indicate that

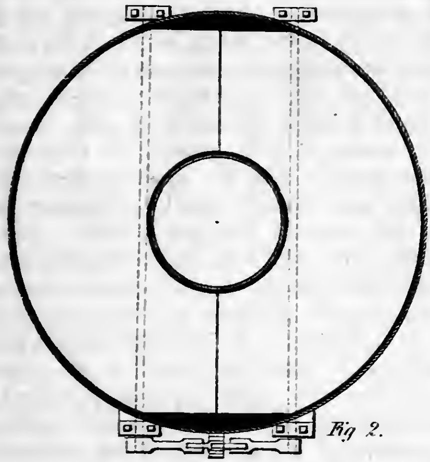


Fig 2.

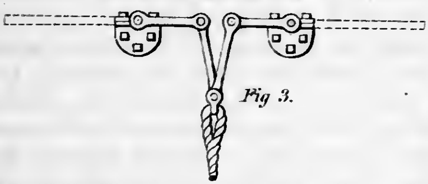


Fig 3.

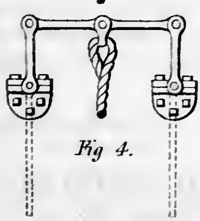


Fig 4.

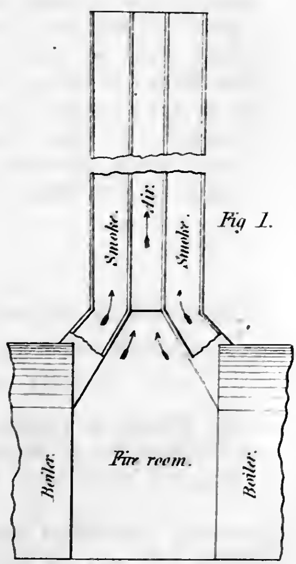


Fig 1.

portion of the cross area of the smoke pipe not covered by the dampers, for it is evident, that with this arrangement the entire area cannot be covered, the vacant spaces being the two segments of a circle having for arc a part of the periphery of the smoke pipe, and for chord, the straight line connecting the points where the axis of the dampers intersect the periphery of the smoke pipe. These small vacant spaces are practically no disadvantage, for the complete closing of a damper is never resorted to on account of the heat and coal gas it would force into the fire-room. The manner of moving both dampers, simultaneously, by one operation, is very simple, and so plainly shown, in Figs. 3 and 4, as to require no detailed description. Fig. 3, shows the position of the links and hand rope when the dampers are closed. Fig. 4, shows the position of the same when the dampers are open. It will be observed that the axis divides the damper unequally, giving a larger area upon the outer than upon the inner side, which is required in order that the dampers may assume the vertical position when the hand rope is slackened.

I am, however, of opinion, that ash-pit doors and not a damper in the chimney are the proper means of stopping the supply of air to the furnaces. The great recommendation of a chimney damper, will be found in its convenience, for it allows the draft of all the furnaces to be stopped at once by one operation; while, on the contrary, if ash-pit doors are used, the closing of each door requires a separate operation, involving more time and trouble, not to mention the inconvenience of the doors themselves, protruding into the fire-room. Nevertheless, ash-pit doors permanently hinged in pairs on the sides of the ash-pits, are doubtless the best mode of stopping the draft and quickly cooling the boiler; for while they entirely prevent the access of air below the grates and to the fuel, the furnace doors being opened, allow the ingress of a large body of cold air, which rushes in over the fuel, through the flues and up the chimney, thereby ventilating and cooling the fire-room also, instead of heating it, as the closing of a damper in the chimney would do, by throwing out into the fire-room the heat of the furnaces and the gases of the fuel.

Specification of Patent granted to David Hulett, *for improvements in Gas Regulators for regulating the supply of gas to the burner,—being partly a communication.*—[Sealed 4th January, 1854.]*

The object of this invention is to regulate the supply of gas as it issues from the main to the burner, and prevent fluctuation in the height of the flame, notwithstanding any difference that may occur in the pressure of the gas in the main.

The improved apparatus consists of a cast iron vessel with inlet and outlet passages for the admission and emission of the gas: the inlet is covered by a valve, the edge of which dips into a groove containing mercury: this renders the joint perfectly gas-tight without impeding the motion of the valve, which is hung in such manner as to move with the

* From the Lond. Journ. of Arts, Dec. 1854.

slightest variation of pressure. The valve is attached by a rod to a short cylinder, the lower part of which is open, and dips into a channel or groove containing mercury. The cylinder covers and surrounds the inlet passage: thus, as the gas flows from the main through the inlet of the regulator, it exerts an upward pressure on the cylinder, which is adjusted by means hereinafter described, to admit the requisite quantity of gas for the supply of the burners. If the pressure of gas issuing from the main be increased, it lifts the cylinder which closes the valve; but the consumption by the burners quickly reduces the pressure within the regulator: this causes the cylinder to fall and open the inlet passage.

Fig. 1.

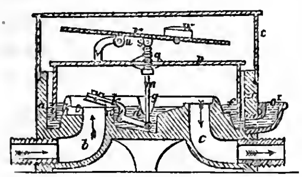


Fig. 1, is a vertical section of the regulator arranged for use. *a*, is a cast iron cylindrical vessel or box; *b*, is the inlet; and *c*, the outlet passage. The passage *b*, is closed by a valve. *d*, is a recess cast in the lower part of the box *a*, and forming a small cistern or reservoir to receive mercury when the regulator is adjusted for use. *f*, is a channel or groove for containing mercury; this communicates with the channel *g*, which conveys the mercury into the cistern or recess *d*.

The mercury or other suitable fluid is poured into the regulator through the tube g^1, by which it is conveyed to the recess *d*, and channels *f*, *g*. *h*, is the valve-seat, which is secured by screws to the box *a*. *i*, is the valve, the rod *k* of which is jointed at *l*, to the seat *h*. To the outer end of the rod *k*, is jointed a small rod or spindle, which supports the cylinder. A groove or channel *n*, is formed in the valve-seat *h*, which surrounds the valve: when this is filled with mercury or other suitable fluid, the valve dips into it, and forms a gas-tight joint. When the valve is secured to the box *a*, the joint of the valve-rod is within the recess *d*, and below the surface of the mercury, as also is the joint of the rod *m*. This arrangement prevents the clogging of the joints, arising from the deposit of oily and bituminous matters. *m*, is the rod or spindle secured at one end to the valve-rod *k*: at the upper part is a nut *o*, upon which the cylinder *p*, rests. The cylinder is made of iron, or other suitable material, and open at the bottom. It is secured to the rod *m*, by a nut, which is screwed down upon the cylinder; and disks or washers of leather are placed between the nuts to render the joint gas-tight.

At the top of the rod *m*, is an eye, to which is fastened a metal bar *r*, by a pin passing through the lugs *s*. The bar *r*, is supported by a rod *t*, which passes through the lug *u*; and the ends of the rod *t*, are supported by the pins or brackets *v*, screwed in the edges of the box *a*. This bar *r*, is perforated, to receive a small weight *w*, by which the pressure of the bar *r*, on the cylinder *p*, is regulated. If it be placed at the back of the fulcrum *u*, or to the left-hand side, as shown, the pressure may be wholly taken off the cylinder *p*; and it will be gradually increased as the weight is moved along the bar. When the regulator is to be adjusted for use, after attaching it to the inlet and outlet pipes, the channel *p*, the recess *d*, and the grooves *f*, *g*, are to be filled with mercury, by pouring it into the pipe or tube g^1, until the metal is nearly evel with the top: a nut is then screwed in the pipe g^1, the gas turned

on, and the weight w, put in a position so as nearly to balance the cylinder p, when the gas is pressing it upward. Any increase of pressure from the main will lift the cylinder p, which causes the valve i, to descend, and shut or partially close the inlet until the pressure becomes uniform. On the contrary,—should the pressure from the main decrease, the cylinder will descend and open the inlet passage to a greater extent. The regulator being properly adjusted as before described, the cover x, is put on to secure the internal parts from injury: the apparatus will then require no further attention.

A modification of the foregoing is represented in vertical section at fig. 2. It consists of a cylindrical box a, a; of which b, is the inlet, and c, the outlet passage. Into the bottom of the vessel is screwed the piece of brass d, or other metal, the inside of which is grooved out, as shown at d^1. The valve e, is hollow, and slides over the piece of metal d; and three or four steadying pins project from the inside of the valve to keep it equidistant from the metal d. The valve is attached to a rod f, to which the cylinder g, is secured, as in the arrangement before described. The lever h, and other working parts, being above the cylinder, are not within the influence of the gas. The pressure of the lever on the cylinder is adjusted in the same manner as before described. When the cylinder is lifted, the valve is drawn upward, and the angular edge of the aperture i^1, in the partition i, dips into the groove formed round the top of the valve, by the edge e^1, rising a short distance above the curved top. The groove is filled with mercury, to make a gas-tight joint when the edge of the partition i, dips into it. One or more apertures are made in the upper part of the valve to maintain an equality of pressure on poth sides of the valve. The direction of the gas as it passes through the regulator is indicated by arrows.

Fig. 2.

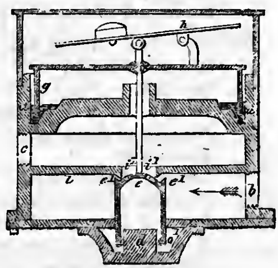
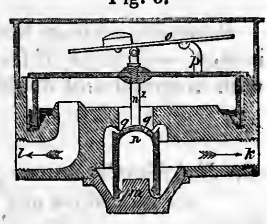


Fig. 3, is a vertical section of another arrangement of regulator: k, is the inlet, and l, the outlet passage; m, is a grooved piece of metal containing mercury; n, the valve connected to the rod n^1; o, the lever; and p, the lever-supports. When the valve is lifted by a variation of the pressure, the curved edge of the metal q, dips into the mercury; thus stopping the passage of the gas. The action of the other parts of the apparatus is similar to the foregoing. In all cases the regulators are to be provided with covers, as shown in the figures. The material preferred for the manufacture of the valves is malleable iron coated with tin, in order that the mercury surrounding the valve may adhere to it when it descends, and make the joint gas-tight.

Fig. 3.



The patentee claims the construction of the apparatus for regulating the flow of gas, substantially as herein described and shown.

For the Journal of the Franklin Institute.

Particulars of the Steamer Joseph Whitney.

Hull built by John Englis, New York; Machinery by Neptune Iron Works, New York; Intended service, Baltimore to Boston.

HULL.—

Length on deck, from fore part of stem to after part of stern post, above the spar deck,		200 feet.
Breadth of beam at midship section,		33 "
Depth of hold,		9 "
" " to spar deck,		16 " 6 inches.
Length of engine and boiler space,		63 "
Draft of water at load line,		11 "
" " below pressure and revolutions,		11 "
Tonnage, custom-house,	1000.	
Area of immersed midship section at this draft,		308 sq. feet.
Masts and rig,	foretopsail schooner.	

ENGINE—Vertical beam.

Diameter of cylinder,		52 inches.
Length of stroke,		11 feet.
Maximum pressure of steam in pounds,	25.	
Cut off,	½.	
Maximum revolutions per minute,	18.	

BOILER—One—Rising flue.—

Length of boiler,		28 feet.
Breadth "		14 " 9 inches.
Height " exclusive of steam chimney,		10 " 2 "
Number of furnaces,	4.	
Breadth of "		3 " 4 "
Length of grate bars,		7 " 3 "
Number of flues, (upper return,)	8.	
Internal diameter of flues,		16¼ "
Heating surface, (fire and flues,)		2303 sq. feet.
Diameter of smoke pipes,		55 "
Height, "		35 feet.
Description of coal,	Bituminous.	
Draft,	Natural.	

PADDLE WHEELS.—

Diameter,		29 feet.
Length of blades,		7 " 6 inches.
Depth "		18 "
Number "	26.	

Remarks.—Floor timbers at throats, *molded*, 14 inches;—*sided*, 14 inches;—distance of frames *apart at centres*, 24 inches. Frame strapped with diagonal and double laid iron straps 4 by ⅝-inch. C. H. H.

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*On Hutchison's Process for Indurating and rendering impervious to moisture Sandstone and other Porous Stones, Plaster of Paris, &c.**

Some time ago, when a French inventor, M. Rochas, was seeking to introduce his process for silicatising soft stone, and even for staying the progress of decay in stone buildings already erected, we spoke of Mr. William Hutchison's patent for indurating and rendering impervious to

* From the London Builder, No. 613.

moisture soft sandstone and other porous stones, plaster of paris, and various absorbent materials. Since that time a company has been formed to carry out the patent, and we have taken an opportunity which was offered us to inspect the works, and to examine some of the examples of the indurated stone which have been longest exposed to wear and the weather. The works at present in operation are at King's Quarry, close to Tunbridge Wells, which is held under a lease from the Earl of Abergavenny, and furnishes a stone so soft and friable that it may be reduced to powder with very little difficulty. The sandstone, grits, &c., are affected by the weather, either by the mechanical effects of moisture admitted into the interstices, or through the decomposition of the matter cementing the particles together; and Mr. Hutchison's patent, it will be seen, fights against both these operations. The process is extremely simple; perhaps we ought to say the processes; at all events, two modes are employed, the one changing but slightly the color of the stone, the other rendering it much darker, in fact, nearly black. The latter is much the cheaper process, and is performed with ordinary gas tar, purified, and to some extent changed by successive boilings. In a large tank of this, over a furnace, the pieces of stone are placed, and remain on an average about six hours. In some pieces that we broke, the tar had penetrated three or four inches on all sides, and in others had permeated the whole mass. After the stone has been taken out of the tank and cooled, the surface is cleaned off. To preserve a light color the stone is dipped into boiling resin instead of tar.

By the process the stone is made very hard, its specific gravity is considerably increased, and it is rendered non-absorbent. A three-inch cube of stone prepared by the first described mode, after being steeped in water for twelve hours, had gained no appreciable increase of weight; while a similar cube of the stone, in its natural state, absorbed two ounces and a half of water. The stone of which we are speaking, is altogether useless in its natural state. Searching for specimens of the prepared material which had been exposed for some time, we found a tomb-stone that had been out for three years, whereof the arrises were perfectly sharp and untouched; a *grindstone* which had been in use four years, and some pavement lozenges of the black and white alternately, that had been laid the same number of years, and were very sound. Being impervious, it serves to keep down the damp. Copings, sinks, and horse-troughs, appeared to have stood well. For use in hydraulic works, sea walls, dock-basins, tanks, &c., it would appear to have strong claims. We should add that the invention is not confined to stone in a solid state; pounded sandstone or other material may be mixed with loam and rendered hard and impervious by introduction to the tank. We found the workmen, in this way, manufacturing stable-pitching, out of material otherwise useless.

The *Sussex Advertiser* looks to the invention hopefully, as promising great results as regards the district, which has at present, "so to speak, no special manufacture, no distinctive 'staple' of industrial trade." "The important merit," says the writer, "in Mr. Hutchison's invention is the striking fact, that out of two materials—each comparatively valueless in

itself, viz: sandstone and gas tar—he produces by direct amalgamation, under certain processes, a most valuable and highly useful commodity. It has been held that that man is a benefactor to his country who can make two blades of grass grow where only one grew before; Mr. Hutchison has done more; he has taught us to convert two bodies, nearly useless in themselves, into a material whose uses can scarcely be circumscribed; while, be it added, this material can be furnished at a rate little beyond, we believe, half the usual cost of ordinary stone."

Sir Roderick Murchison, the well-known eminent geologist, has expressed an unqualified opinion in favor of the process. In a letter to the patentee, Sir Roderick says: "Believing that your method of indurating the soft sandstone of this neighborhood, and of rendering a material which is so easily worked as *durable as the hardest rock*, and quite impenetrable to moisture, I sincerely wish you may have that success to which you are justly entitled. It is manifest that, in a climate like this, a cheap building stone, which *throws off wet and never can absorb it*, must be highly valuable, not only in the construction of houses, but in all hydraulic, paving, and monumental work." He goes on further to say: "When I further know that every sort of decoration can be chiseled out at the very slightest expense, and with great rapidity, and that in a few hours the material can be rendered *an indestructible rock*, *with edges that can only be destroyed by violence*, *and never can be affected by weather*, I conceive that your patent only requires to be known in order to be generally appreciated." We do not go as far as this: we may not pretend to say that the stone as thus prepared "*never can* be affected by weather." Time must settle that question. But it certainly does seem clear to us that in many localities, and for many purposes, the process we have been describing may be employed with very great advantage to the public, and much profit to the owners of the patent.

There are two architects, we observe, connected with the company, namely, Mr. N. E. Stevens, of Tunbridge Wells, (who, by the way, has built some picturesque houses there and in the neighborhood,) and Mr. Edward Roberts, of London. We sincerely hope the undertaking may prove successful.

For the Journal of the Franklin Institute.

Holstrom's Improved Air Lock for the Sinking of Hollow Iron Piles, Coffer Dams, &c.

Many of the readers of the *Journal*, have no doubt heard of the process of Dr. Potts, in England, for sinking hollow iron piles, which process consisted in simply closing the upper end of the pile air-tight, the lower end being left open, and having a thin edge for the more readily cutting its way. The pile having been set in a vertical position, a pipe is attached to the top bonnet, and a communication opened between the interior of the pile and a large exhausted receiver, the pile, as it were, receives a blow from the atmosphere, caused by the partial vacuum which is instantly formed within it; the pumps which formed the vacuum in the receiver are kept constantly at work, and bring up from the

inside, water, sand, gravel, &c., or whatever may be the formation in which the pile is being sunk; if, however, any opposing obstacle is encountered through which the atmospheric pressure on the top and hydrostatic pressure at the sides cannot force, it becomes necessary to resort to other means, and it is at this stage of the operation that Holstrom's improvement becomes essential to a successful prosecution of the work.

The Wilmington and Manchester Railroad Company, in crossing the Great Pee Dee River, in South Carolina, have put down a bridge composed of these piles; whole length of bridge, 335 feet; width, 18 feet 6 inches; there are two spans of 130 and 135 feet, and one of 70 feet, which is used as a draw for steamboats. In this bridge there were used seven hollow cast iron piles, 6 feet diameter, 2 inches thick, and 53 feet long, weighing about 25 tons each. In sinking the first pile, when it had gone down 7 feet 10 inches, it was found to have met with an obstruction which prevented further progress. On examination, the obstruction was found to be a large cypress tree, covering one-half the bottom area of the cylinder; its removal became a matter of necessity. By the use of Mr. Holstrom's improved air lock, patented January 2d, 1855, further operations may be immediately carried on. The air lock is a chamber bolted to the top of the pile, and having suitable openings at the top communicating with the atmosphere, and at the bottom communicating with the inside of the pile. As soon as the pile is obstructed, the doors in the air lock are opened, and the workmen enter the pile. The pumps, which had previously exhausted the air, are now reversed and air forced in until all the water inside the pile is expelled, when the men work at and remove the obstacle that opposes the pile. As fast as it is removed from below, it is placed in the air lock, the inner doors of which are open, and the outer ones closed. When the lock is filled, the inside doors are closed, and the outer doors are opened when the lock is emptied; by this means a constant pressure is kept within the pile, and men and material can be passed in or out at pleasure, without interfering with the operation. N.

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*The Mints of France.**

France possesses seven mints; before 1814 there were as many as eighteen, but at that period eleven were suppressed, including the following among others,—Bayonne, La Rochelle, Limoges, Nantes, Perpignan, and Toulouse. Each of the existing establishments make use of a peculiar mark on its coinage to designate the mint in which it is struck. Thus the coins of the Paris mint bear the letter A; Rouen, B; Lyons, D; Bordeaux, K; Strasbourg, BB; Marseilles, MM; Lille, W. But of these seven, Paris is the only mint that has kept up an uninterrupted coinage of gold and silver money; and it is only since the copper coinage was re-melted that the provincial mints have evinced any activity.

It is a known fact, that the coinage in France is not undertaken by the State, but by contractors, who are styled Directors of the Manufacture, and who are subjected to a system of superintendence and registration.

* From the London Mechanics' Magazine, October, 1854.

The State allows them for cost of coinage at the rate of a franc and a half per kilog of silver (about 2 lbs.,) and six francs for the same weight of gold. The directors of the mint are required to supply one-fortieth of the silver coinage in fractional parts of the five-franc piece; that is to say, 25,000 francs worth out of every million of francs. It is thus distributed, —5250 francs worth (or about 210*l.*) of 2 franc pieces; 12,250 francs worth (or 490*l.*) of franc pieces; 6250 francs worth (or 250*l.*) of pieces of 50 centimes; and 1280 francs worth (or 50*l.*) of pieces of 20 centimes. The tenth part of the gold coinage is to be in ten franc pieces. The cost of the copper coinage is a franc and a half (about 1*s.* 3*d.*) per 10,000 francs worth (or 400*l.*) It is difficult to form an idea of the magnitude of the arrangements of the Paris mint. The results already attained are astonishing; nor less so are those within the reach of its machinery, such as the furnaces, crucibles, rolling mills, presses, milling and cutting apparatus, &c., which are contained in a comparatively small compass. Two steam-engines of 30 horses power work the various apparatuses which prepare the strips for feeding the coining presses. Each press, attended by a single workman, strikes off 50 coins per minute, and might be made to work off 60 by slightly increasing the speed. It is calculated that if each press were to strike off 50 coins per minute during 12 hours per day for 300 days in the year, the 16 presses would produce nearly 3,500,000,000 francs (or 140,000,000*l.*) worth of 20 franc pieces; 1,700,000,000 francs (or 68,000,000*l.*) worth of 10 franc pieces; 864,000,000 francs (or 34,560,000*l.*) worth of 5 franc pieces; 639,360, 000 francs (or 25,574,400*l.*) worth of pieces of 2 francs, 1 franc, 50 and 20 centimes; and above 31,000,000 (or 1,240,000*l.*) worth of pieces of 5, 2, and 1 centimes.—*Translated from Moniteur Industriel.*

To the Editor of the Franklin Institute Journal:

In page 90, August number of the *Practical Mechanics' Journal*, is a notice of a method of securing a piston upon its rod, which we think is original with our Lewis Taws, and was first used at our establishment. The drawing from which the cut was taken, was furnished by us.

We have for several years secured all our large pistons in this manner, and are satisfied that it is an improvement.

Other engineers have understood its value, and are using it. As there is no patent claim for the arrangement, it seems proper, that any credit which may attach to it, should accrue to its originator.

We shall be gratified, if you will copy the article referred to, for the *Journal of the Institute.*

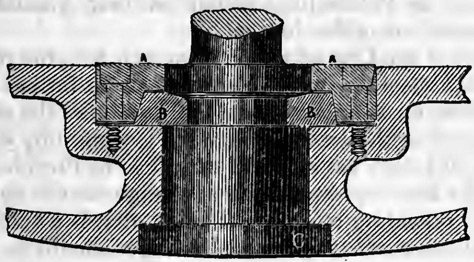
We are very truly, I. P. Morris & Co.,
Port Richmond Iron Works.

Philadelphia, January 23, 1855.

Method of securing a Piston upon a Rod.

The firm of I. P. Morris & Co., of Philadelphia, about the year 1850, originated a mode of securing a piston upon its rod, which has since been adopted in all engines constructed by them, and is now beginning to attract some attention in other quarters. The rod is forged considerably larger than usual at the end, and is held so that the impulse of the piston

in either direction is received fair upon a collar, instead of, as usual, bearing a wedge-wise one way, and on the narrow base of a cutter the other way. The annexed figure is a vertical section through the central portion of a piston, exposing the piston-rod in position, with the loose ring, A, held down by a few light bolts. This ring is formed with an inner conical surface, embracing two half rings, B, which enter a groove in the piston-rod. The downward pressure of the ring, A, tightens the pieces, B, upon the rod.



These wedge-pieces, B, correspond to the key of the ordinary fastening, and bear the whole force of the piston while on the upward stroke, the downward strain being borne by the still larger collar, C, on the end of the piston-rod. The pieces, B, are so formed, that, when fairly in place, they make a nearly continuous ring around the piston-rod. Being set up twice, once when cold, and again when heated, a strong, fair, and perfectly rigid joining is secured for these important parts, which are subjected to no trifling amount of strain. The steamer *Mississippi*, running on Lake Erie, the first large boat in which this device was ventured on, has a cylinder 81 inches in diameter, and employs a plus pressure during a portion of the stroke, of as much as 30 lbs. per square inch. Add to this, 10 lbs. for vacuum, subtract 1 lb. for friction, and a very simple calculation shows the alternate thrust and pull on the piston-rod to be something more than 200,000 lbs. There is no patent for this fastening, which has so far proved in every case perfectly successful.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, January 18, 1855.

Samuel V. Merrick, President, in the chair.

John F. Frazer, Treasurer.

John P. Parke, Recording Secretary, pro tem.

The minutes of the last meeting were read and approved.

A letter was read from the Metropolitan Mechanics' Institute, of Washington City, D. C., and referred to the Committee on Instruction.

Donations to the Library were received from the Royal Astronomical Society, and the Statistical Society, of London; the National Observatory, Washington City, D. C.; the Maryland Institute, Baltimore, Md.;

Charles B. Norton, Esq., City of New York, and Messrs. J. K. Lippincott and George M. Conarroe, of Philadelphia.

The periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer read his statement of the receipts and expenditures for December; also, his annual statement for 1854.

The Board of Managers and Standing Committees reported their minutes.

The Committee on Publications submitted their Annual Statement of the financial operations of the Journal.

At the request of the Committee on Minerals, &c., the regulations submitted at a former meeting, were referred back for further consideration.

New Candidates for membership in the Institute (10) were proposed, and those proposed at the last meeting (157), were duly elected.

Mr. Merrick said that, having held the office of President for the past thirteen years, he had requested that a change should be made at this election in the presiding officers, believing that it would be to the advantage of the Institute that occasional changes should be made in those offices.

A letter was read from Thomas Fletcher, Esq., approving of the proposition to make a change in the presiding officers.

The Tellers of the Annual Election for Officers, Managers, and Auditors, for the ensuing year, reported the result, when the President declared the following gentlemen as duly elected:—

John C. Cresson, President.

John Agnew, Matthias W. Baldwin, } Vice Presidents.

Isaac B. Garrigues, Recording Secretary.

Frederick Fraley, Corresponding Secretary.

John F. Frazer, Treasurer.

MANAGERS.

Samuel V. Merrick,	Owen Evans,	Charles E. Smith,
Thomas Fletcher,	Alan Wood,	John McClure,
Abraham Miller,	John E. Addicks,	George Erety,
John C. Trautwine,	Isaac S. Williams,	Evans Rogers,
John H. Towne,	Henry P. M. Birkinbine,	Robert Cornelius,
Edwin Greble,	George W. Conarroe,	Lawrence Johnson,
David S. Brown,	Thomas J. Weygandt,	George C. Howard,
Thomas S. Stewart,	Joseph J. Barras,	Harman Baugh.

AUDITORS.

Samuel Mason, Algernon S. Roberts,
James H. Cresson.

At a meeting of the Board of Managers, held January 24th, 1855, the following officers were elected for the ensuing year.

Isaac S. Williams, Chairman.

Thomas J. Weygandt, Owen Evans, } Curators.

Washington Jones presented to the notice of the meeting, some specimens of Japanese arts and manufactures, brought by an officer attached to the Japan Expedition. Among them was an umbrella, or rather a sun-shade, made in an exceedingly neat manner; the material being nearly all of bamboo, or a similar wood; the covering of oiled paper pasted to the stretchers. No metal, except a piece of iron wire to make a catch, to keep the slide in its position when the article is opened.

Some sheets of the paper used by them to write upon, having a resemblance to tissue paper, soft, and with little or no sizing; yet it is said that with a suitable pen, and the ink (resembling that of the Chinese, and probably identical with it in its manufacture,) used by them, it can be written upon with ease and rapidity.

Also, a stuff, seemingly made of the waste silk rejected as unfit for weaving, which appears to have been manufactured by spreading the material into a very thin flake, saturating it with a gummy substance, then drying it, and finally stamping it upon one side with figures of various designs. This is applied to the purposes of a pocket-handkerchief, the only difference in the application being this; the Japanese article performs its office but once. A number of pieces, each of a sufficient size to accomplish its purpose, are carried about the person; when necessity requires, a piece is used, and then thrown away as unfit to be returned to the pocket. A trial proves the stuff to be unable to withstand washing, the water dissolving the substance that binds the fibres together, and reducing them to a mass.

There were also some beautiful specimens of domestic utensils made of wood, bowl-shaped, provided with covers of the same material, and coated with red and black lacker, highly polished, and ornamented with figures of animals, scenery, &c., laid on with white and yellow metal. These vessels are used to contain warm food, and are cleansed with hot water without sustaining injury.

The specimens of porcelain cups shown, were very fine, transparent, and entirely free from blemish. When held between the light and the eye, there may be seen portions that transmit the rays more readily, and which are so disposed as to make continuous lines that form figures of a regular design.

The interior surface of the cups are ornamented with views of Japanese scenery, alphabetical characters, and foliage, laid on with white metal, like that on the wooden vessels, and similar in design to those of the Chinese, but much more artistically executed. All the articles shown, compared very favorably, in point of finish and display of taste, with those of a like kind made in China.

Mr. J. F. Mascher exhibited a stereoscopic locket, of his invention. It is so arranged that the two pictures, with the appropriate lenses, are contained in a medallion of ordinary size. The pictures are covered by plano-convex lenses, instead of flat glass, by which improvement the ordinary secondary reflexion is avoided. The lenses for viewing the portrait are double convex, of two inches focus; these may be combined when desired for viewing ordinary objects.

Dr. Rand exhibited a glass tumbler, which, having been cracked in two, had been mended by a Chinese workman. Holes were drilled in the glass by means of a sharp stone placed in the end of a piece of bamboo. The holes did not pass through the glass, and, by means of copper wires inserted into them, and dexterously bent, the two halves were firmly joined, so that the vessel has been used for months without injury. The operation occupied half an hour, and its cost was five cents.

BIBLIOGRAPHICAL NOTICES.

Discoveries in Chinese; or, the Symbolism of the Primitive Characters of the Chinese System of Writing. By STEPHEN PEARL ANDREWS. New York: Chas. B. Norton, 1854: 12 mo. pp. 187.

This very prettily got up little work has been laid upon our table, hardly, however, we hope, in the expectation that we should review it. Our great respect for that nation of industrious and ingenious workmen has never been able to induce us to study their language; and we look for the solution of all international problems, by inducing John to learn our language and customs, in place of requiring us to master his bundle of clumsy symbols. We are, therefore, unfitted to judge the work before us, "ex cathedra;" but it appears to us that the system is more plausible than sound, and the analogies traced more ingenious than convincing. We have read it, however, with a good deal of interest, and have at least learned from it as much as we ever did from any other treatise on the same language. F.

De Bow's Review, Industrial Resources, &c. Publication Offices, New Orleans, La., and Washington, D. C.

Our valued exchange, *De Bow's Review*, has commenced, with its January number, a new series, and with the most flattering prospects of achieving the success which it so fully merits. It presents itself to us in an enlarged form, and additional quantity of matter, while the good management of the Editor insures us against a deterioration of quality in its contents. The readers will find in it a number of articles devoted to the development of the industrial resources of our country, which render it invaluable to our agriculturists, merchants, and manufacturers. We rejoice at its prosperity, and wish it long life to enjoy the success which it has so fully earned.

Erratum.

Vol. 28, 3d Ser., (Nov. 1854,) page 340, 7th line from top—for "*Blowing Engines,*" read "*Slowing Engines.*"

// JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

PROMOTION OF THE MECHANIC ARTS.

MARCH, 1855.

CIVIL ENGINEERING.

For the Journal of the Franklin Institute.

On Errors committed by Writers on Mechanical Engineering. By WILLIAM TRURAN, Esq.

The science of engineering has advanced with immense strides during the last few years, until it has become the great agent of civilization and commerce. Examples of successful engineering structures, which, but a few years since, would have been considered impossible, are now of almost daily occurrence. In road-making, bridge-building, steam-navigation, and manufactures generally, we see the rapid progress of engineering science. Many of these great works have been designed and erected by self-educated men; but in the present day, the man who has received a combined theoretical and practical education, can undertake a work with an assurance of a successful completion, which the former cannot. The publication of numerous valuable works on engineering and mechanics, has placed the means of acquiring the theoretical principles of these sciences within the reach of the practical and the self-educated man. It is to be regretted, however, that in several instances, the theories laid down for guidance, are manifestly incorrect, and have caused much embarrassment to the student, and great loss of time and capital to the practical man.

In this and future papers, we purpose drawing the attention of theoretical and practical engineers to some of the most obvious and common errors which are to be met with in publications intended for their especial use. We will begin with one which is found in nearly every text-book

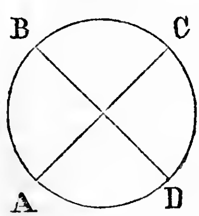
on mechanics, and which seems to have originally emanated from a celebrated French philosopher:

"Two men working at a windlass with handles at right angles, can raise 70 pounds more easily than one can raise 30 pounds." *"Desaguliers."*

On an attentive consideration, the incorrectness of this statement will be evident to the student. If one man is capable of raising 30 pounds only, two men will raise twice this weight, or 60 pounds, and not 70 pounds, as Desaguliers asserts. If we deny the correctness of this dictum, we must be prepared to show the source from whence any additional power over the 60 pounds is obtained. This we are unable to do satisfactorily. Were we to admit that a gain of power resulted when two men were at work, we must also allow, that with an increased number of men, the gain of power will be correspondingly great.

It is very probable that the inference intended to be drawn from the statement, was the benefit which would accrue by having the two handles of a windlass at right angles to each other, instead of being diametrically opposite, as we observe them to be in practice. But to assert that by such arrangement the men can easily raise one-sixth more than if the handles were otherwise set, is manifestly incorrect. It requires no mathematical investigation to ascertain that if a weight of 30 pounds is to be raised, the requisite power must be exerted, and if 35 pounds is to be raised, a proportionately greater power must be exerted, whatever apparatus be employed for transmitting that power.

The mistaken impression, that a gain of power follows when the handles of a windlass are set at right angles, is unfortunately current among a large number of practical engineers, and prevails, also, with the majority of educated scientific men in Europe. That no gain or advantage can really accrue in practice by such arrangement, a brief consideration of the conditions under which a man labors at a windlass will prove.



Let the annexed diagram represent the circle described by the handle of a windlass during one revolution; the motion being in the direction of the letters. For convenienc of reference, the circumference of the circle has been divided into four equal parts opposite the letters A, B, C, and D. Assuming that one man is at the handle of the windlass, which stands at the usual height, we shall perceive by reference to the diagram, that in moving from A to B, the man applies his power by lifting; one of the most favorable positions in which a man can exert his strength. Generally, a man can lift nearly one and a half times his own weight. From B to C, the power is applied by pushing—the resistance being nearly on a level with his chest. The force which a man can exert at this height is small, certainly, not exceeding the half of the weight of the operative. From C to D, his power is exerted in pressing down the handle, and the force which can be applied, during this portion of the revolution, is equal to, but cannot exceed, the weight of the man. From D to A, his power is applied by pulling, and in this direction when the line of resistance is low, as in the case of windlasses and boat rowing, he can exert

great power—not less than one and a half times his own weight. With one man only at the windlass, we observe that the power which he is capable of momentarily exerting, varies with the position of the handle, being at one period nearly three times the amount exerted at the least effective point.

With two men working with handles set at right angles, the irregularity of the power which the men are capable of exerting, is nearly as great as with one man. For if we suppose that when one handle is at A, the other is at D, the two positions in which the greatest force can be exerted; and that in revolving they will afterwards be at B and C—the two points where the least power can be exerted by the men,—it is difficult to see how the arrangement of the handles thus can be conducive to regularity of motion, much less to the absolute gain of power, as many persons maintain.

The believers in this gain of power have evidently overlooked the important fact, that during the revolution of the winch handle, the varying positions which a man takes, render him less or more powerful throughout. The power is not equally great at all points during the revolution, but at no time is it entirely suspended. There are no dead centres like those in a crank, worked by a connecting rod. The operative exerts at the least effective period, full one-third of the power which he is capable of exerting under any circumstances, and considerably more than he is capable of maintaining for any length of time.

Were there two points in the revolution of the handle, at which a cessation of the propelling power took place equidistant from each other, the arrangement of the handles at right angles to each other would tend to equalize the power, but a consideration of the diagram demonstrates that a considerable diminution in the power takes place at one period only. At the point opposite to this diminution of power, the man is capable of exerting his greatest effect; therefore, the greatest uniformity in the motion will be obtained when the handles are so arranged that, while one is passing over the space during which the least effective power can be exerted by the operative, the other shall move in the direction in which he can exert the greatest power. This is accomplished by placing the handles diametrically opposite to each other.

In practice, we invariably see the handles placed on opposite centres. On examining cranes, crab-winches, windlasses, or any other machines on the same principle, we do not find the handles at an angle to each other, but the reverse. When placed diametrically opposite, the operative imagines, and not without reason, as we have endeavored to show, that the work is easier than when placed at right angles or in the same plane; and there is the further advantage, that being on opposite centres the weight of one handle balances the weight of the other.

That this common mistake regarding the extra power got by setting the handles at right angles, is not confined to a few persons, but is believed in by some of the ablest writers, we will endeavor to show, by making an extract from a letter, written by Mr. J. C. Robertson, C. E., and for nearly thirty years editor of the *London Mechanics' Magazine*, to a private correspondent, dated March, 1849:

"The force of two men rightly applied to a crank, is more than twice one in the proportion of 70 to 60."

When the editor of the *London Mechanics' Magazine*, a civil engineer, and one of the ablest writers on mechanics and mathematics of the day, believes in such gain of power, we may well excuse a similar mistake in less able men. But with all due deference to Mr. Robertson's abilities as a writer and mathematician, we must doubt his obtaining from two men more than twice the power of one.

In Europe this imaginary gain of power by the employment of cranks at right angles, has, in numerous instances of mechanical engineering, been productive of much complexity of construction and great waste of capital. Practical engineers have reasoned that if there is a gain of power by disposing the handles of a windlass at right angles, a similar disposition of the cranks of machines driven by steam, water, or other inanimate power, would be attended with like advantages, and have constructed their engines and machines with such cranks, in the full belief that a positive gain of power is thereby obtained. On no other supposition can we account for the immense number of steam engines in Europe having two cylinders with their cranks at right angles. Where the power required to be given out by such engines is so great, that manufacturing engineers have not machines of the requisite calibre for their construction, the employment of two cylinders may be advisable. In ocean going steamers, also, the employment of two engines may be attended with some advantage in the facility of repairing, and the ability to continue the voyage if one engine is disabled. And in locomotive engines, the use of two cylinders is probably attended with advantage.

But the universal employment of two engines in river going steamers, and the very general use in all land engines, for mining, and driving mills, factories, blowing machines, &c., of two cylinders, can be attended with no advantage, commensurate with the greater first cost of such engines over single cylinder engines of equal power, and the greater cost of maintaining them in an efficient working state. The first cost of two engines, as compared with a single engine of equal power, will be as 4 to 3. The cost of repairs and renewals will be in the proportion of 3 to 2, and the loss of power from friction and leakage will be in a similar ratio. Hence a single engine, of given power, will cost one-fourth less at first, and may be worked with one-third less expense in repairs and leakage, than a pair of engines, collectively, of the same power.

For the Journal of the Franklin Institute.

On the Durability of Railroad Iron. By William Truran, Esq.

The duration of the iron rails of our great railroads is a subject of vast importance to all interested in the maintenance and extension of railway communication. In all estimates for new roads for thinly settled districts, the cost of the iron rails figures as the most prominent item; and even in the thickly settled States of Europe, where the metal is obtained at a comparatively cheap rate, the cost of the rails forms no inconsiderable portion of the whole expense of construction. On the first introduction of railroads, it was confidently asserted by their promoters, that the iron

rails would last for an indefinite period. A few months working, however, demonstrated that although manufactured from the best metal, iron railway bars were subject to lamination and disintegration from the repeated rolling of heavy loads. Their duration, in numerous cases, did not exceed two or three years, and in no instance of a railroad having a heavy traffic, have the rails remained sound and in working condition for more than 14 years. On some of the earliest constructed lines in England, the rails have been changed twice and even three times within twenty years. Opportunities have, therefore, presented themselves to the engineers of such lines, of ascertaining the actual traffic which iron rails are capable of withstanding under different circumstances. But if note has been taken of the facts relating to rails which have been taken up, it is to be sincerely regretted, that they have not been recorded in one of the numerous scientific publications of Europe or this Country. Their publication would be of the greatest benefit to railroad companies, and, eventually, would be of esential service to engineers and scientific men generally.

The traffic which rails of ordinary quality are capable of bearing, will depend on circumstances; but where the conditions are of a favorable nature, and the bars themselves perfectly sound, it will not fall far short of twenty millions of tons. But, although rails will stand the rolling of this traffic, those which are daily observed in a dilapidated state on numerous railways, have not, in the majority of cases, carried the one-fourth of this traffic; and immense quantities of rails have doubtlessly been renewed before they have borne the one-tenth of this weight. Well recorded observations are wanted on this head, and pending the publication of more extended observations, the writer would direct attention to the following observed cases of rails, which have stood the carriage of several millions of tons under very disadvantageous circumstances.

It may be necessary to state, that the rails used in every case, but the last, were of the usual quality, (those in case 2 are a portion of the bars manufactured for the Moscow and St. Petersburg railway.) They were manufactured in manner commonly pursued at Welch rolling mills, and were, in point of quality and appearance, equal to any manufactured, or in use in Europe. The rails in the Hirwain road were rolled from inferior metal, and were not, in other respects, well manufactured.

It may be necessary also, to mention in this place, that the gross weight of the trains is given in every instance. This, it is believed, is preferable to giving the weight of the freight and omitting the weight of the engine and cars, which may be unnecessarily heavy or light for the loads which they convey.

Case 1. Railroad for the conveyance of minerals, near Merthyr Tydfil, Wales, length, 2 miles; gauge, 4 feet 8·5 inches. This line is a gradient of 2 inches rise in the chain through its whole length, and contains curves so low as 3 chains radius. The wagons employed weigh 3 tons 12 cwts. when empty, and 7 tons 1 cwt. when loaded. They are mounted on 4 cast iron wheels, 30 inches in diameter, keyed fast on the axles, and have outside bearing brasses, but neither buffer, draw, nor bearing springs. The motive power consists of locomotive engines weighing

from 14 to 16 tons each, exclusive of tender. The rate of hauling, ranges from 10 to 16 miles an hour.

This line was originally laid in a very temporary manner, with bridge rails 2·5 inches high, 2 inches wide at the top or bearing part, and 6 inches at the foot; and weighing 56 lbs. per yard lineal. They were fastened by spikes through the flanches to cross sleepers, 6 inches by 4 inches, by 6 feet long, at intervals of 4 feet. The ballasting consisted of the clay and peaty soil excavated from the side drains, and distributed in a layer one foot thick under the sleepers.

After two years' wear, with the engines and wagons described above, the original rails were laminated to an extent that rendered their renewal a matter of necessity. The gross traffic that passed over them during that period, amounted to 1,822,800 tons. Had these rails been supported by larger sleepers at shorter intervals, and these sleepers packed up by proper ballasting, they would have stood the wear and tear of from twice or three times the above quantity of traffic.

Case 2. The railroad previously described, was relaid with T rails 3·75 inches high, 2·5 inches wide at the head, and 3·5 inches broad at the foot; and they weighed 63 pounds per lineal yard. The small sleepers were replaced by others, averaging 9 inches wide, by 9 feet long, at the reduced distance of 3 feet apart from centre to centre. The rails were also supported on shallow cast iron chairs, which were spiked to the sleepers, and the clay ballasting was strengthened by the addition of a thick layer of broken stones. The new rails with the altered mode of laying, have now been in use ten years, during which period the gross traffic over them has been 9,710,000 tons.

The height of these rails when new, was 3·75 inches, as previously stated, but by wear and abrasion from the rolling of the above weight, their height has been reduced to 3·63 inches. Taken collectively, these rails have endured very well, and with the exception of a very few crushed and bruised bars, which will require immediate renewal, they will, probably, continue fit for the traffic for at least three years again. Hence their duration may be estimated as equal to the movement of 12,600,000 tons.

To show the ill effects which must result from inattention to the state of the sleepers, at different places on the line, a sleeper end was permitted to remain without proper support. After the lapse of a few days, the rails immediately over the slackened sleepers, were found crushed and flattened for a length of 6 or 7 inches, so as to reduce the depth of the bar from 3·63 to 3·2 inches. Similar results followed, when the distance between any two sleepers was increased to more than 4·5 feet; thus showing the necessity of having, under the rails, a firm and rigid support at very short intervals, to prevent as far as possible all injurious deflexion.

In those rails which have broken down, either from lamination, or during the foregoing experiments, the impropriety of using any other than puddled iron in the top surface of the rail was fully displayed. These rail bars were manufactured from piles of the ordinary quality and description, with a top plate of the so-called "best iron," one inch in thickness. This plate in the course of rolling was reduced in thickness,

to ·16 of an inch in the finished bar. Now, all the lamination which has yet been discovered, has occurred with this superficial coating of "best iron," which has often pealed off, in long narrow strips or splinters, of several feet in length.

Case 3. Mineral railroad, consisting of a steep incline plane of the 4 feet 8·5 inches gauge, with a double track of rails, each 480 yards long, and falling 6·7 feet per chain. The direction of the traffic being downwards, this portion is worked by the gravity of the descending full wagons, which are made to draw up the empties, by means of ropes, working over rope rolls and friction drums, revolving on gudgeons at the incline top. The rails were of the bridge pattern, 2·5 inches high, 2 inches wide at top, 6 inches broad at the foot, and weighed 56 pounds per yard. They were supported on flat cast metal chairs, which were spiked to transverse sleepers of 8 inches wide, by 8 feet long, placed 3 feet apart. Under the sleepers, there was a thin stratum of clayey soil as ballast.

The wagons described in case 1, roll over this section, also, at velocities averaging 12 miles per hour. The rails on this section were in use for eleven years, during which time the traffic over them amounted to 8,087,000 tons, equal to 4,043,500 tons over each track. The injury which results to the rails from the absence of adequate support under the sleepers was manifest in this case, and, undoubtedly, was the means of shortening their duration fully one-half.

While forming another mineral railroad, crossing under this section, it became necessary to evacuate an opening, 10 yards wide, over which the rails were carried by four pieces of pine timber; one being placed under the centre of each rail bar. The deflexion of the beams by the passing of the loaded wagons, was from 2·5 to 3 inches, and from this cause alone, the whole of the rails on these pine stringers were battered and laminated so as to require renewal in the short space of two months, and after they had borne a traffic of no more than 61,300 tons.

Case 4. Mineral railroad, on a dead level throughout, consisting of a single track of bridge rails, the same as those described in case 1, but spiked directly to sleepers, averaging 6 inches wide, by 6·5 feet long, placed 3 feet apart on broken limestone, as ballasting. The wagons previously described, work over this section also, but the motive power being horses, the rate of traveling rarely exceeds three miles an hour. The rails on this section have now been in use eleven years, have borne a traffic of nearly 4,900,000 tons, and with the renewal of the wood-work of the line, will probably last for a similar period, and for the passage of an equal quantity of traffic. Their duration may, therefore, be assumed to be equal to the transport of 9,800,000 tons.

From the foregoing examples it will be seen, that while bridge rails, weighing 56 pounds per yard, were destroyed with the passage of 1,822,800 tons, hauled at a velocity of 12 to 16 miles an hour, by locomotive engines, weighing from 14 to 16 tons each; with the same wagons, but at the reduced speed of 12 miles an hour, they have stood under the passage of 4,043,500 tons; and with the same wagons, but at the still further reduced speed of 3 miles an hour, they have stood the wear and tear from the passage of 4,900,00 tons, without material injury.

Case 5. Railroad for the conveyance of coal, consisting of an inclined

plane, falling 7 inches per yard, forming a double track of rails of the 4 feet 8·5 inches gauge, 400 yards long, and worked by stationary steam power at top, through the medium of ropes and drums. The rails are of the inverted U pattern or Evans' patent, weight 90 lbs. per yard, were 3·4 inches high, 2·74 inches wide at the head, 4 inches wide at the foot, rolled in lengths of 15 feet, and supported at intervals of 3·5 feet, by cast iron chairs resting on massive blocks of limestone.

Each track of rails is traversed by a single wagon, mounted on four cast iron wheels, 2 feet diameter, keyed on wrought iron axles, and revolving in brass fitted plummer blocks bolted to the frame work of the wagon. The weight of the wagon when empty is 7 tons 2 cwts., when full, 13 tons 16 cwts., and it is drawn at an average speed of 8 miles an hour.

These rails have now been in use seventeen years, and the gross traffic which has passed up and down the plane, amounts to 11,016,000 tons, or 5,508,000 tons over each track. The result of this traffic has been to reduce the height of the rails from wear and abrasion, from 3·4 to 3·26 inches. In other respects they are in good condition, and will probably sustain a further traffic of 3,500,000 tons, making their duration equal to 8,000,000 tons.

Case 6. Railroad for the conveyance of limestone, a single track $2\frac{1}{2}$ miles long, worked by horse power. The rails were of the fish-bellied section, 5 inches high, 2 inches wide at the head, and ·75 inches thickness of centre web, weighed 55 pounds per yard, and were laid in cast iron chairs, resting at intervals of 3·5 feet on limestone blocks of from $2\frac{1}{2}$ to 3 cwts. each.

The wagons, which were made wholly of wrought or cast iron, weighed, when light, 1 ton 19 cwts., and when loaded, 8 tons 10 cwts. each. The wheels were 2 feet 6 inches in diameter, and turned loosely on the axles, which were bolted to the under side of the carriage.

These rails stood for nine years with an average annual traffic of 180,960 tons, or a gross total of 1,628,640 tons, when they were replaced by stronger bars.

Case 7. Railroad consisting of an inclined plane, with a double track of rails raising 6·7 feet per chain forward. Rails of the bridge pattern, weighing 56 pounds per yard, 2·375 inches high, 2·125 inches wide at head, and 5·625 inches at the foot; spiked directly to cross sleepers 9 inches wide, by 9 feet long, at distances of 3 feet 3 inches apart. The sleepers repose on a thick deposit of broken scoria, from the blast furnaces in the neighborhood, which is found to be an excellent material for ballasting the permanent way of railroads.

The wagons running on this road are of wrought iron, mounted on 4 cast iron wheels, 30 inches in diameter, turning loosely on their axles, and are without springs of any kind. They weigh when light, 1 ton 8 cwts., and when loaded, 4 tons 16 cwts.; and are drawn by stationary steam power acting through drums and chains, at an average speed of 6 miles an hour.

These rails have been in use thirteen years, and appear but very little the worse for the traffic which has passed over them. This has amounted to a gross weight of 7,840,000 tons, or 3,920,000 tons over each track.

Their duration may be fairly estimated at twice this weight, or 7,840,000 tons over each track of rails.

Case 8. Railroads for the conveyance of goods, metals, and minerals, consisting of a single track of rails of the bridge pattern, weighing 75 pounds per yard, 2·5 inches high, 2 inches wide at head, and 6 inches at base, laid in shallow cast iron chairs, which are spiked to sleepers 9 inches wide, by 7 feet long, placed at distances of 3·5 feet apart.

The wagons traveling over this road are of various patterns, and are, with a few exceptions, devoid of springs. Their weight, when empty, varies from 26 to 63 cwts., and when loaded, from 6 to 11 tons. The speed at which they are drawn varies, also, from 3 miles an hour, the speed of those drawn by horses, to 12 miles an hour, for those drawn by steam locomotive engines.

These rails have had the wear and tear from the passage of 4,783,000 tons of miscellaneous traffic, but, from their damaged condition, we cannot estimate their duration at more than 5,500,000 tons.

Case 9. Railroad for the conveyance of coal, consisting of a single track of parallel rails, weighing 40 pounds per yard, 3·87 inches high, 1·87 inches wide at the head, 1·2 inches wide at base, with centre web ·56-inch thick, laid in cast iron chairs pegged to stone blocks, weighing from 4 to 6 cwts. each, and placed at an average distance of 3 feet apart from centre to centre.

The wagons running on this road are drawn by horses at an average speed of 4 miles per hour, and are mounted on four cast iron wheels, 28 inches in diameter, turning loosely on their axles, which are bolted to the wrought iron frame of the wagon. They weigh, when empty, 3 tons, and when loaded, 5 tons 17 cwts.

The gross traffic over this line has amounted, during the 13 years which it has been open, to 8,626,000 tons, and it now remains in a good working condition. The duration of these rails may, therefore, be estimated at about 15,000,000 tons.

Case 10. Taff Vale railroad, for the conveyance of passengers, metals, minerals, and general merchandise, between Cardiff and Merthyr Tydfil. Upper section consisting of a single track of parallel rails of the single head form, weighing 50 pounds per yard, 4·5 inches high, 2·2 inches wide at head, 2 inches width of lower web, and ·66-inch thickness of centre rib or web, supported at intervals of 3 feet by chairs bolted to cross sleepers 10 inches wide by 9 feet long. The ballasting under the sleepers consists of a thick stratum of broken cinders.

The wagons and carriages running on this road, vary considerably in their weight—from 2 tons 10 cwts. to 4 tons 10 cwts. when light, and from 8 tons to 12 tons when loaded. They are furnished with wrought iron wheels and tyres, bearing springs and friction brakes, and the passenger carriages have buffer and draw springs. The locomotive engines employed, weigh about 20 tons, exclusive of tenders, and work at speeds varying from 15 miles per hour, for slow mineral trains, to 30 miles an hour, for passengers.

These rails have been in use nearly 13 years, and from the most careful computations, the traffic over them has been 5,400,000 tons. At the crossings and portions of the line where a considerable braking power is

applied, their depth is reduced, by abrasion, to 4·4 inches, but in all other respects, these rails are generally sound. Their duration may be estimated as equal to the rolling of 10,000,000 tons.

Case 11. Taff Vale Railroad,—the down-line from the Aberdare junction to Cardiff. Length of the line, 14 miles, and falls at the rate of 15 feet per mile. Rails of the parallel double headed section; depth, 5 inches; width of head and foot, 2·5 inches; centre web, ·75 inch thick; weight, 72 lbs. per yard. They are supported at intervals of 2 feet 9 inches by cast iron chairs firmly bolted to cross sleepers, 10 inches wide by 9 feet long. In all other respects, the formation of this road is similar to that of the upper section near Merthyr Tydfil.

The carriages and engines last described, work on this section also, and at similar speeds. It is traversed daily by 3 passenger, 1 mail, and numerous luggage, metal, mineral, and merchandise trains. The passenger trains average about 96 tons gross each, but the mineral and other trains sometimes exceed 1000 tons in weight.

From the annual traffic reports of this company, we find that in the eight years that these rails have been laid, the gross traffic which has rolled over them, amounts to 20,516,000 tons. Although this weight has caused considerable lamination and abrasion at the stations and on the sharpest curves, these rails are now in fair working order, and with attention to the sleepers and ballasting, they will last for the conveyance of as much more. Hence, their duration may be estimated as equal to the rolling of 41,000,000 tons.

Case 12. Taff Vale Railroad,—the up-line from the shipping port of Cardiff to the Aberdare junction. This line is of the same length, and is similar in its construction to the down line, with which it runs parallel throughout. It is traversed, also, by the same engines and carriages, but the coal and coke wagons pass over this line empty.

The rails are of the same date as those on the down line, and the gross weight which has rolled over them, amounts to 11,200,000 tons. Their general condition is very similar to those in the down line; and their duration may be estimated as equal to the passage of an additional weight of 11,200,000 tons, or a gross total of 22,400,000 tons. The greater weight traversing the down line, is owing to the large quantities of coal sent down for shipment; the wagons used in the conveyance of which, return empty over the up line to the collieries.

The rails on both sections having suffered nearly alike in lamination and abrasion, although one has sustained little more than half the rolling of the other, is accounted for by the circumstance of the gradient being just sufficient to enable the engines and loaded wagons to roll down the one line, while on the other the ascent with 90 or 100 empty wagons is accomplished with difficulty by engines having 18 inch cylinders. The abrasion and injury to the rails by the slipping of the engine wheels in ascending gradients, is probably equal to, if it does not exceed, that from the rolling of the traffic.

Case 13. Railroad for the conveyance of minerals to the Hirwain Iron Works, consisting of a single track, 3 miles long, of the 4 feet 8·5 inch gauge. Rails, of a parallel single head form, 4·25 inches deep, 2·5 inches wide at the head, and ·75-inch thickness of centre web. They

weigh 46 pounds per yard, and are screwed fast to single cheek chairs on massive stone blocks every 4 feet. The ballasting consists of blast furnace cinders, and dust from the coke yard.

The carriages are constructed of wrought and cast iron frames, and are mounted on 4 cast iron wheels 32 inches diameter, turning loosely on axles bolted firmly to the carriage frame. They weigh when light 2 tons 5 cwts., and when loaded, 5 tons, but are unprovided with any springs. The locomotive engines weigh 10 tons each when in running order, and propel the loaded carriages at an average speed of 10 miles an hour.

This road has been laid with these rails about 4 years. The gross weight which has passed over it in that time amounts to 1,055,000 tons. On carefully examining the state of the rails after this traffic, 23 per cent. were found laminated to an extent rendering their immediate replacement by sound rails indispensable; while the others cannot, under existing circumstances, last more than 2 years again. The duration, then, of the rails on this road may be estimated as equal to the passage of 1,318,000 tons, or considerably less than either of the previous examples.

In reference to the foregoing examples of the duration of railway bars under different conditions of laying and working, we may remark that in every instance where, in the construction of the permanent way, sufficient solidity has not been obtained by the employment of adequate sleepers, the destruction of the rails has been most rapid. This was the result with cases 1 and 6, and the effects are visible in 3, 4, 5, and 8. The greater duration of 11 and 12 over the others, must be ascribed to the use of heavy rails, wagons, and carriages with bearing springs, and a well constructed and carefully maintained permanent way. No. 12, is a very favorable instance of durability—probably, equal to any ever laid, which has principally resulted from the very favorable grade of the line. No. 10, with heavier rails, would have equalled No. 11, as the conditions are otherwise similar. The absence of bearing springs to all the wagons, except those in cases 10, 11, and 12, must also have had a very prejudical effect on the rails and greatly lessened their duration. In case 6, the rails were too weak, and the support unequal to the heavy wagons employed. Case 9, with heavier blocks and lighter wagons, is a very favorable specimen of a mineral railroad. Case 13, shows the most unfavorable results of the whole number detailed, but when the very inferior quality of the metal used and the defective nature of the fastening employed is fully considered, a different result could scarcely be expected.

In the tabular statement of the duration of the rails, it is supposed that the cost of labor and materials in replacing unsound bars and the ultimate expenses incidental to the entire renewal of the rails, when worn out, will be equivalent to the value of the old metal obtained. This is found to agree very nearly with the results obtained in practice.

We have in our possession, similar notes respecting the duration of cast iron rails, of which numerous examples may be seen at or in the neighborhood of Merthyr Tydfil; but the general abandonment of this material for that of wrought iron, would cause such notes of little value, if published.

Tabular Statement of the Duration of Iron Railroad Bars.

Number of case or example.	Weight of rail (in pounds) per yard.	Depth of rail, in inches.	Bearing surface presented by sleepers for each lineal foot of track, in superficial feet.	Greatest weight rolling on 4 wheels, in tons.	Greatest weight on a foot lineal of track, in tons.	Velocity of trains in miles per hour.	Motive power employed.	Gross traffic over a single track of rails before renewal, in tons.	Weight of rails per mile for a single track, in tons.	Cost of rails per mile estimated at 50 dollars per ton.	Number of tons carried over one mile of road for each dollar's worth of iron consumed.
1	56	2·5	·75	16	2·7	16	Locomotive,	1,822,800	88	4400	414
2	63	3·75	2·25	16	2·7	16	"	12,000,000	99	4950	2424
3	56	2·5	1·75	7·	1·2	12	Gravity,	4,043,500	88	4400	919
4	56	2·5	1·1	7·	1·2	3	Horses,	9,800,000	88	4400	2227
5	90	3·4	1·7	14	2·	8	Stationary,	8,000,000	142	7100	1126
6	55	5·	1·1	8·5	2·2	3	Horses,	1,628,640	86	4300	378
7	56	2·37	2·1	4·8	1·5	6	Stationary,	7,840,000	88	4400	1781
8	75	2·5	1·5	11·	2·4	12	Locomotive,	5,500,000	117	5850	940
9	40	3·87	2·5	5·9	1·3	4	Horses,	15,000,000	63	3150	4126
10	50	4·5	2·5	16	2·8	30	Locomotive,	10,000,000	78	3900	2564
11	72	5·	2·7	16	2·8	30	"	41,000,000	113	5650	7256
12	72	5·	2·7	16	2·8	30	"	22,400,000	113	5650	3964
13	46	4·25	2·	10	2·1	10	"	1,318,000	72	3600	363

For the Journal of the Franklin Institute.

Disquisition on the Laws regulating the Slips of Screw Propellers in function of Form and Dimensions; based on a Digest of the Experiments made in 1845 *by M. Bourgois, Engineer de Vaisseau, at the French Government Manufactory at Indret.* By B. F. Isherwood, Chf. Eng. U. S. Navy.

The following experiments on various screw propellers, were made in 1845, by M. Bourgois, Engineer de Vaisseau, at the government manufactory of Indret, in France; where he was furnished with the requisite manual force, a boat and a considerable number of experimental screws of different forms and dimensions. This was about the time that experiments were being made with the "*Rattler,*" "*Archimides,*" "*Napoleon,*" and other screw vessels; it was in the very infancy of screw navigation, and before sufficient experimental data, on a large scale, had been obtained to indicate the proper proportions of a screw and the laws governing its mode of action. The necessity for a correct theory of the screw was pressing, for the above mentioned experiments on a large scale were neither sufficiently varied nor sufficiently accurate to furnish it; nor has this want been satisfied to the present time by any systematic experiments on the scale of actual practice, accurate enough and varied enough to resolve the various problems of the screw: and it is only by digesting together the many unconnected and occasional experi-

ments which have been made at different times, under different circumstances, by different persons and on different vessels, that we can now make an incomplete theory of the screw, and give an approximately correct answer to specific questions regarding it in function of form or dimensions. The power at the command of Bourgois was not of the kind that entitled him to furnish data for the formation of a complete theory of the screw ; it consisted of the varying manual force of men impossible to be measured ; he was therefore obliged to address himself entirely to the problem of slip, and this he solved very satisfactorily and with much sagacity of manner, if we consider the means at his disposal, and the scale on which he experimented ; and to this day, I regard his experiments as among the most complete and systematic that have been made, losing nothing of their value by the lapse of time. His original report has never, to my knowledge, been published or referred to in English, and possessing a copy in French, I have carefully reviewed and examined the voluminous tables of detail embraced in it, and have extracted from them such data only as were consistent with each other and with the nature of things, rejecting a considerable mass of what was contradictory and evidently erroneous. The data so selected, and which I am persuaded from its close agreement with each other, and from the comparable manner in which it was obtained, is very accurate, I have made the ground of the present paper ; the conclusions drawn, the accompanying remarks, and the arrangement are my own. I have drawn on the report for the original experimental data only. Owing to the want of knowledge of the power exerted with the different screws, this data is strikingly deficient when we attempt to ascertain either the relative economical efficiencies of the different screws as a whole, or to analyze the distribution of that power with a view to determine the value of the friction of the screw surface on the water. These important questions must therefore be left unanswered, and the sole problem resolved by the experiments, is, as before mentioned, the slips of the screw as affected by form and dimensions. The results, therefore, hereafter given, do not, it must be distinctly understood, indicate the relative economical efficiencies of the screws, but only their relative slips.

Objections may certainly be made to these experiments on account of the small scale on which they were conducted ; but such objections, if closely examined, will be found more specious than real. And the very smallness of the scale, allowed the experiments to be so often repeated and varied, and with such a degree of exactness in the determination of all the elements of time and dimensions, as would be hopeless on a grand scale ; where the number must necessarily be limited, the determination of the elements inexact, the labor immense, and all the difficulties and liabilities to error great. Experiments on a grand scale would be vitiated by many accidental circumstances impossible to guard against, and whose effect could neither be calculated nor eliminated from the general result. In confirmation of this, it is only necessary to refer to the experiments on the "*Rattler*," "*Dwarf*," and many other screw vessels.

Manner of Experimenting.—A convenient place was first selected on the river, where the bank was straight and the water nearly on a level

with it, and a base was marked out by two javelins or staves placed 328 feet apart, and ranging with other staves at right angles to this base. The experiments were conducted here until a rise in the river overflowed its banks, when a second similar base was marked out, but only 219·76 feet long. In order to be certain that the experiments made on the two bases were comparable, a screw, which had always given consistent results on the first base, was experimented with on the second base; the mean slip obtained on the first base was 38·7 per centum, on the second base 39·4 per centum; we are therefore warranted in assuming the results on both bases, as comparable, and this assumption is further confirmed by the according results of a great number of other experiments. One observer in the boat counted the number of revolutions of the crank shaft from the instant of departure to the instant of arrival, while another observer took the time elapsed between the same departure and arrival. Every care was taken to insure extreme accuracy; the base was run over forward and back, and the mean results taken to give the slip of that trial; this double course was again run, and the mean results obtained gave the slips; again, a number of double courses were so run with each screw, and not content with this, but to avoid error from inexactness in the form of the screw surface, each screw, after being first experimented with, was reversed on the shaft, and the number of trials repeated with the other face of the blades; the means of all the trials with both faces were taken to give the true slip of the screw. In the part of the river chosen for the two bases, the current was always very feeble. The screw shaft was geared to make 9·88 revolutions for each revolution of the crank shaft, which latter was turned by four sailors; there was a double set of gearing, the driving wheels of each set containing 44 and the pinions 14 teeth.

Of the Experimental Boat.—This boat was of iron and had the following dimensions, viz.

Length between perpendiculars, ...		26·26 feet.
Extreme breadth, (outside of iron,) . . .		5·09 "
Depth of hold, ...		2·87 "
Draft of water, at which all the experiments were made,	forward,	1·35 "
	mean,	1·575 "
	aft,	1·80 "
Greatest immersed transverse section at above draft, .		6·458 sq. ft.

A number of experiments, carefully made with a dynamometer to ascertain the resistance of this boat, gave 13·23 pounds avoirdupois, at a speed of 3·281 feet per second, or 2·237 statute miles per hour. A great number of experiments, employing the various screws, were also made to determine whether an increase in the speed of the boat affected the slip of the screw; or, in other words, if the slip of the screw was influenced by its rotary speed. This rotary speed was greatly varied, in some cases 70 per centum, but no greater variations of slip were observed than the slight discrepancies inevitable to all observations of this kind; sometimes an increased speed gave a slightly increased slip, sometimes a slightly decreased slip. There results from this, that within the limits of speed employed, viz., 4 statute miles and under per hour, the *resistance* of the boat was in the ratio of the square of its speed, requiring the *power*

to propel it to be in the ratio of the cube of its speed. It was found, by experiments with two screws, that the fouling of the immersed surface of the boat by the collection of slime, &c., during 15 days of repose, increased the resistance sufficiently to cause an increase in the slip of one screw from 35·6 to 38·6 per centum, and in the slip of the other screw, from 37·4 to 39·4 per centum. Before experimenting, therefore, care was always taken to clean the bottom of the boat. It was also found, that a slight rocking of the boat materially increased its resistance, and, consequently, the slip of the screw; for instance, a screw that gave a slip of 31·4 per centum with the boat steady, gave a slip of 33·4 per centum when it was slightly rocked.

Material of the Screws.—The screws of the first and fifth series were made of wrought copper beaten very thin. Those of the second, third, and fourth series, were made of tinned wrought iron and bound with two circles of iron wire around the periphery; the screws of these latter series were not full threaded, that is to say, the blades did not descend to and unite with the hub, but the interior part, or portion adjacent to the hub, was cut out in a manner that may be imagined by passing through the screw a cylinder of the diameter of the cut out part, and having an axis coinciding with the axis of the screw; the blades were attached to the hub by copper arms of sufficient size for stiffness; these arms must, necessarily, by their direct resistance, have somewhat increased the slip, but they could not influence the relative value of the slips of screws of the same series. The screws with curved generatrices and directrises were made of zinc beaten to the required form on a wooden die. The screws of the first and fifth series, I shall call "full threaded screws;" those of the second, third, and fourth series, I shall call "part threaded screws."

Definitions.—Before proceeding further, it will be proper to give a few definitions of the terms herein employed in relation to the screw; which when considered abstractly from solidity, that is to say, mathematically, and formed by lines and superficies only, is termed a *helicoid.*

Let any right line whatever be taken and called the *axis of the helicoid.* And let any other line, curved or straight, of definite length, be taken, lying at any inclination to the axis and with one extremity touching the axis; this line is termed the *generatrix of the helicoid.*

Now let the generatrix be kept at the same inclination to the axis, and let its outer end be moved with a rotary speed around the axis, while its inner end is moved simultaneously along the axis, it will generate a twisted surface, termed a *helicoid.* The length of the generatrix is the *radius* of the helicoid.

The outer extremity of the generatrix, during the generation of the helicoid, will describe a line curved in projection and in elevation: this line is termed *the helix of the helicoid.* The helix is the *directrix of the helicoid.*

When the generatrix has an uniform rotary speed around the axis and an uniform rectilineal speed along the axis, the distance it moves along the axis during the time it is making one revolution around the axis, is termed the *pitch of the helicoid,* and the helicoid so generated, is termed a *regular helicoid.* If the rotary and rectilineal speeds of the generatrix, or either of them, be not uniform, there will be generated a helicoid of

irregular pitch, that is, the generatrix will momentarily describe helicoids of different pitches, each pitch being what would have resulted had the corresponding momentary speeds been kept uniform for one revolution around the axis.

If, now, we suppose the generatrix to move along the axis with an uniform speed, while it moves around the axis with an uniformly decreasing speed, or vice versa, it will generate an *irregular helicoid,* having an uniformly increasing pitch, or an *expanding pitch*, as it is commonly termed.

If the helix of a regular helicoid be projected on a plane, that is to say, if the circumference and pitch be made the sides of a right angled triangle, the helix, which will be the hypotheneuse, will be a straight line, and such a helix is termed a *straight directrix.* But, if the helix of a helicoid of expanding pitch be similarly projected, it will, instead of being a straight line, be a curved line, and such a helix is termed a *curved directrix.*

Whether the helicoid have a *straight* or *curved generatrix*, depends, simply, whether a straight or curved line was taken for it. If a curved line be used, the helicoid will be concave on one face, and convex on the other.

If the mathematical right line, constituting the axis of the helicoid, be replaced by a cylinder, and a straight generatrix be used with the inner end kept tangent to the cylinder, an *oblique helicoid* will be generated, having an acute angle for one face, and an obtuse angle for the other. Such a generatrix is termed an *oblique generatrix.*

When the mathematical helicoid is formed of matter, it is termed a *screw* ; the right line axis is replaced by a *hub*, and the superficies is replaced by a *thread.* When the thread is divided into two or more parts and placed around the hub, these parts are termed *blades.* *One convolution of the thread* is formed by exactly one revolution of the generatrix around the axis, and if viewed projected on a plane at right angles to the axis, would appear a disk : in such a case the *whole pitch* is said to be used. If any less portion of the thread than one convolution be used, *a fraction of the pitch* is said to be used.

Kinds of Screw.—The screws experimented with, were of the following kinds, viz.

1st. *Full threaded* screws with straight generatrices and directrices, formed of exactly one convolution of the thread, but having it divided into several blades.

2d. *Part threaded* screws with straight generatrices and directrices, formed of exactly one convolution of the thread, but having it divided into several blades.

3d. Full threaded screws with straight generatrices and directrices, formed of *fractions of the pitch*, and having the thread divided into several blades.

4th. Full threaded screw composed of a fraction of the pitch, with an *oblique generatrix* and a curved directrix.

5th. Full threaded screws with *curved directrices*, composed of the whole and of fractions of the pitch, with straight generatrices.

Objects of the Experiments.—With the above kinds of screw, it was

sought to determine the variation of slip *in fraction of the form* of the screw, as follows, viz.

1st. The influence exerted on the slip by cutting out the inner portion of the blades.

2d. The influence exerted on the slip by employing less than one convolution of the thread, or by fractioning the pitch.

3d. The influence exerted on the slip by employing an oblique generatrix.

4th. The influence exerted on the slip by employing a curved directrix, or expanding pitch.

5th. The influence exerted on the slip, by the division of the same propelling surface, into a more or less number of blades.

Subordinately to these, it was essayed to determine the influence exerted on the slip by surrounding the periphery of the screw with a drum of very thin metal, fastened to and turning with the blades.

Also, the influence exerted on the slip of the screw by placing the blades checkerwise, that is, by moving back the distance of the length of the blades and in a line parallel with the axis, half the blades of the screw; by which means the length of the hub will be doubled, and the screw will present the appearance of two similar screws on the same axis placed one immediately after the other, with the blades of the last intersecting the spaces between the blades of the first.

In function of the dimensions of the screw, it was essayed to determine the influence exerted on the slip :—first by the pitch, and second by the diameter.

Experimental Data.—Bourgois, in his voluminous tables, has entered all the detail of the experiments; such as the time elapsing between departure and arrival, number of revolutions made by the screw, speed of the screw, speed of the vessel, &c.; but it is obvious, that as the speed of the screw did not affect its slip, it is unnecessary here to occupy ourselves with such unimportant detail, whose only value consists in the fact of its furnishing the means of arriving at the final results we are in quest of. I shall, therefore, in the following tables, only include in addition to the dimensions of the screws, their mean slips, and their minimum and maximum slips; and the number of double courses ran with each screw, counting once forward and once back over the base as a double course.

In comparing the experimental data, the screws are of course supposed to preserve, when propelling in water, the same form they possess when in repose: nevertheless, they are subjected, when propelling to a strong force, directly to the alteration of their form. For it is a well known fact, which, beside, is fully established by these experiments, that the propelling efficiency of the blade rapidly diminishes as we pass from its anterior to its posterior edge; that is to say, considerably increasing the length of the blade, but slightly diminishes its slip. Now the slip of the screw, which is the difference between its longitudinal speed and the speed of the boat, measures simply the difference between the resistance of the vessel and the resistance of the water pressed by the screw; hence it follows, that when by lengthwise addition of surface to a screw its slip is but slightly decreased, additional surface experiences only a slight resistance from the water it presses corresponding to the slight decrease

of slip. The strain, then, of the water pressed by the screw instead of being equally distributed over the surface of the blade is principally at the front or anterior part, diminishing very rapidly as we approach the posterior part. Now, if the metal of the blades is made *very thin*, as in the screws of these experiments, and has not perfect stiffness, it is plain they will yield or spring back; and the anterior part having more strain upon it than the posterior part, will spring back more; consequently the angle made by the blades with the axis when propelling, will not be the angle when in repose, but a greater angle, giving the screw, when propelling, a greater pitch than it has when in repose. Were there no slip at all, and did the screw thread its way through the water as in a solid nut, it is plain that then every part of the blade, considered lengthwise, would experience an equal resistance from the water pressed: but in proportion as slip exists, so does the pressure at the anterior part increase disproportionately over that at the posterior part; for the greater the speed with which the water is set in motion (*i e.* the greater the slip), by the anterior part, the less pressure will evidently be impressed upon it by the posterior part following with the same speed as the anterior part. Hence we find, that the screws giving greater slips should have more alteration of form, that is, more increase of the pitch, when propelling than when in repose, than the screws giving lesser slips.

With regard to screws of different diameters; when the blades are made of metal so thin as to spring, it is clear, that the screws of least diameter will have the least alteration of pitch, because there is less strain upon them; therefore, in such screws the pitch will not increase when propelling so much as in screws of greater diameter over the pitch they have when in repose.

This alteration of the pitch of the screws when propelling from what they had when in repose, and which must have become permanent after the screw had been used a considerable number of times, owing to the excessive thinness of the blades, was quite overlooked by Bourgois, who was not a practical mechanician, and he proceeded to erect upon all the experimental data obtained, a number of empirical formulas involving the higher mathematics, for the calculation of the slips of screws of variously modified forms and dimensions. These formulas with the value of their elements controlled by assumed coefficients, will therefore apply only to cases where the blades spring the same as in his experiments, and where all the other accidents were likewise the same, and as they are not only false in themselves, but quite useless practically, it is unnecessary here, either to discuss or reproduce them. The results of Bourgois' experiments are certainly somewhat vitiated by the change of shape underwent by his screws when propelling from what they had when in repose, which latter forms, of course, the elements of comparison, but the vitiation is not so great in the data I have selected as to prevent these results from being, in my opinion, very valuable. Some of the screws are strictly comparable, and if in all cases the exact amount of influence exerted on the slip by different modifications of the form and dimensions of the screws is not determined, still a very close approximation is given, and the direction in which the changes operate clearly indicated.

In some of the experimental screws, the pitches are evidently erro-

neously given, and these screws I omit in the general tables, first and second, which include only those screws whose results are comparable. But as experiments were made with some of these omitted screws, which were strictly comparable with each other, such as reducing the number of blades one by one, cutting out the inner part of the blades, and shortening the length of the blades, I have discussed their results separately.

(To be Continued.)

Thirty-fifth general Report of the Chesapeake and Delaware Canal Company, June 5, 1854.

The President and Directors of the Chesapeake and Delaware Canal Company, in making their thirty-fifth annual report to this general meeting of Stock and Loanholders, have pleasure in stating, that the business, during the past year, has been conducted with regularity, and without accident or serious interruption to the constantly increasing trade.

The tow-paths, drains, and bridges have all been extensively repaired and improved, and the works generally are now in better condition for the transit of boats and vessels, than they have been at any time since the opening of the Canal.

From the statements of the Treasurer, herewith presented, it will be perceived that the revenue from tolls, for the year ending May 31, 1854, amounts to the sum of	\$246,695·02
The contingent and incidental expenses, which include all items for repairs, interest on loans, officers' salaries, wages, and contingent charges, for the same period, amount to	\$200,131·46
Leaving a surplus of (nett profits arising from tolls,)	\$46,563·56

This surplus, under the provisions of the Charter, might be divided among the Stockholders, being the actual profits of the Company, above interest and expenses, arising from tolls ; but in view of the present financial wants of the Company, growing out of the enlargement of its locks, it is recommended that no dividend be now declared, but that this amount may be carried to the credit of a dividend fund, that it may be kept, so as to be distributed among the Stockholders at some future day, when the Company may find it more convenient to do so than at present.

It is proper, in this connexion, to state, that to the clear income from tolls, as already stated, there may be added the further sum of \$15,429·06, of revenue derived from interest, dividends, rents, &c. The total clear revenue would then stand as follows:

Revenue from tolls, ...	\$46,563·56
" " other sources, ...	15,429·06
Total revenue, clear of interest and expenses,	\$61,992·62

At the last general meeting of the Stock and Loanholders, the necessity for additional and larger locks was communicated to the meeting.

By a resolution then adopted, the Board was authorized to undertake the necessary measures for the accomplishment of that purpose. The Board immediately proceeded to the execution of this important work.

Having secured the services of Ashbel Welsh, Esq., an eminent and distinguished Engineer, the surveys and necessary explorations, preliminary to the etablishment of the sites for the new locks, were commenced and prosecuted, and after a full examination of the nature of the ground in which these locks were to be placed, the Engineer recommended to the Board, the location of two locks, one at St. George's and the other at Delaware City, on the south side of the present ones at those points, and the location of a single lock at Chesapeake City, on the north side of the two now at that place, having the same lift as both of them.

After a full consideration of all the circumstances connected with this important work, the Board came to the conclusion, that locks of 220 feet long by 24 feet wide were most advisable, and it was therefore decided to have them constructed of these dimensions. The plans and specifications having been prepared by our Engineer, proposals for the construction of the locks were advertised for, and the contract for them, under the direction and supervision of the Engineer, was awarded to Messrs. Candee, Dodge & Co.

The completion of these locks, though delayed beyond the time expected and contracted for, is now near at hand; the work has been a difficult one, requiring energy, skill, and constant attention to avoid serious accidents and interuptions to the trade of the Canal, but the Board have great satisfaction in being able to state, that they consider the works now so far progressed as to be free from all danger of casualty, and that pending their construction, up to this time, there has been no accident, and that the trade upon the Canal has not been interrupted for an hour.

The results of the year's business have been highly satisfactory—the receipts of the year ending May 31st, 1854, (the largest of any preceding year,) were unnaturally swelled by having not only the usual timber trade of that year, but a great portion of that of the prior year thrown into it, in consequence of the low stage of water in the spring of 1851 in the Susquehanna, which prevented the floating of timber.

Notwithstanding this, and the fact that owing to the very severe winter and late spring of the present year, which has deprived us of the ordinary trade on the Canal during these seasons, the receipts of this year slightly exceed those of the last year.

The Board, therefore, feel fully warranted in saying, that the business of the year just closed, exhibits the same general improvement, which has marked that of each preceding year; and, in assuring the Proprietors, that, after the completion of the new locks, which will give such important increased facilities, the business of the Company must and will continue to increase from year to year, for many years to come.*

To meet the expenditures for the construction of the new locks, and other expenses necessarily incidental thereto, it was deemed proper by the Board to increase the capital of the Company, by an additional Loan. At separate meetings of the Stock and Loanholders, held at the office of

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* Between the opening of the Tide-water Havre-de-Grace trade and the first of June, instant, there have passed between Havre-de-Grace and Philadelphia, through the Chesapeake and Delaware Canal, 50,282 canal boats, without loss, excepting that which occurred to some two or three boats in a towage on the western end of the line, and in one or two other single instances of boats to a small extent.

the Company, on the 18th day of July, 1853, after due notice had been given of said meetings and of the purpose for which they were called, the propriety of obtaining the Loan was sanctioned and approved by a majority in interest of the whole number of Stock and Loanholders. A call for proposals for $250,000 of this Loan has been made, and proposals have thus far been received to the extent of $180,000, with every prospect that the balance will be taken by the first of July, before which time the money will not be needed.

ANDREW C. GRAY,
President Ches. and Del. Canal Co.

Philadelphia, June 3d, 1854.

AMERICAN PATENTS.

List of American Patents which issued from December 19*th*, 1854, *to January* 23*d*, 1855, (*inclusive*,) *with Exemplifications.*

DECEMBER 19.

73. For a *Feeding Apparatus to a Machine for Cutting Irregular Forms;* Charles P. Bailey, Zanesville, Ohio.

Claim.—"The hinging or pivoting of the rest to the table, and uniting the carriage that carries the block and pattern thereto, by means of a mandrel, which may be turned at pleasure by a helically grooved rod or shaft, for the purpose of cutting twisted or spirally formed pieces as they pass the cutter head."

74. For an *Improvement in Condensers;* Samuel W. Brown, Lowell, Mass.

Claim.—"1st, The lever valve, in combination with the inclined plane on the top of the movable lever, or with a stationary incline plane, for the purpose of opening this lever valve with an increased power when the condenser descends by the yielding of the tube to which it is attached, this yielding being caused by the weight of the water of condensation. 2d, Suspending the condenser by a tube of metal, or other substance, so remote from the bearing on which this tube rests, that it will yield or spring downwards by the weight of the water of condensation sufficiently to open a valve, or its equivalent, which allows of the escape of this water, and retains the steam."

75. For an *Improvement in Metal Separators;* Thomas J. Chubb, City of New York.

Claim.—"The arrangement of a series of guide plates or compartments above the sieve, a series of tubes or plates below the sieve which I call a sieve bed, the bellows for supplying the blast, the guide plates or scrapers."

76. For an *Improvement in Cleaning Seed Cotton and Feeding it to the Gin;* Major B. Clark, Newnan, Georgia.

Claim.—"The combination of a series of parallel bands, operating as a feeding apron, with a toothed roller, the teeth being so arranged on the roller as to pass between the feeding bands, whilst the arms of a beater are so arranged as to pass between the teeth of the said roller, and strip them of the cotton as it is carried forwards."

77. For a *Double Acting Force Pump;* D. W. Clark and S. H. Gray, Bridgeport, Con.

Claim.—"The combination of two pistons and piston rods with one pump barrel and one brake, when one of the rods is made to pass through the hollow interior of the other, and when both rods are connected with the brake by means of the connecting links and cross levers."

78. For an *Improvement in Bilge Supporters for Holding Vessels in Docks;* Horace J. Crandall, Boston, Massachusetts.

Claim.—"The making of bilge supporters with standards and braces, with rocker

movable joints, with the shieves or rollers, and rails for the bilge supporters to rest or move upon when not loaded, and for the use of dry sectional or railway docks."

79. For an *Improvement in Guards for Ferry Boats;* Daniel Fitzgerald, Thos. Rogers, and Wm. C. Walker, City of New York.

Claim.—"1st, The use of the cat head and connected apparatus to effect, at the arrival of the boat, the removal of the guard. 2d, The removal of the guard by the action of the boat against the apparatus. 3d, The self-closing of the passage by the withdrawal of the boat."

80. For an *Improvement in Clover Harvesters;* John S. Gage, Dowagiac, Michigan.

Claim.—"Gathering clover and other seeds from the standing stalks, by means of a hollow cylinder provided with a series of toothed bars, so that the teeth of said bar will, as the cylinder rotates, be forced outward through holes in front of the cylinder, and comb the seed and chaff from the stalks, the teeth being drawn within the cylinder when at its top, and the seed and chaff stripped from them, so that it may pass into the box or body."

81. For an *Improvement in Grain Mills;* George W. Grader and Benjamin F. Cowan, Memphis, Tennessee.

Claim.—"Regulating the feed by the combination of a spring and an eccentric jut."

82. For a *Direct Action Water Wheel;* Stephen Hadley, Jr., Lyman, N. Hampshire.

Claim.—"1st, The form and construction of my wheel, as follows: making the surface upon which the buckets are affixed concaved or bell-shaped, in combination with spiral-formed buckets, so curved as to meet the water on their face, perpendicularly to its course, and gradually diminishing their capacity from the centre to the periphery. 2d, The adjustable collar, bevel wheels, and gear wheel, combined to train and sustain the wheel, and adjust it perfectly to the stationary parts. Lastly, in combination with the above described wheel, the stationary cap inclosing the moving buckets."

83. For an *Improvement in Machines for Straightening Heavy Metal Bars;* Isaac B. Howe, Northfield, Vermont.

Claim.—"The combination of a lever beam, sliding fulcrum, operating screw, and sliding yoke or hold fast, whereby I am enabled to obtain the advantage of leverage, in combination with a screw power, for bending the rail when the machine is applied thereto."

84. For an *Improvement in Registering Dynamometers;* W. B. Leonard, City of N. Y.

Claim.—"The registering dynamometer for rotary motion, which is made up by the combination of an indicating dynamometer for rotary motion, with a registering apparatus, by means of a controlling connexion."

85. For an *Improvement in Sash Fasteners;* Charles Merrill, Malden, Massachusetts.

Claim.—"The arrangement of a wedge and its mortise plate with a spring bolt and its catch plate, so as to operate for the purpose of drawing the sashes together, when fastened with a spring bolt."

86. For an *Improvement in Making Sugar Moulds;* James Myers, Jr., City of N. Y.

Claim.—"Filling the space between the base band and the mould case with moulten iron, or other suitable metal, in such a manner that the metal, by uniting with the base of the mould case, will, when cooled, form a complete and durable armor for the same."

87. For an *Improvement in Composition for Tanning;* G. Reynolds, Bangor, Maine.

Claim.—"The above described composition, consisting of muriate of soda, alum, and sulphuric acid, this composition to be dissolved in water, for treating hides, or converting them into leather without depilating them."

88. For an *Improvement in Cut Nail Machines;* J. P. Sherwood, Fort Edward, N. Y.

Claim.—"1st, Connecting the tube to a vibrating carriage, and combining said tube and carriage with the sliding plate, the lever, the hook, the cam wheel, and shaft, in such a manner that the forward end of said tube will be elevated during the first half of its semi-rotary movement, and be depressed during the latter half of said movement, and then be firmly held in a depressed position a sufficient length of time for a nail to be cut from the nail plate. Also, the combination of the flaring jaws with the end of the tube, in such a manner that they can be so adjusted as to enable them to unerringly

guide a nail plate of any width to the cutters, when the machine is in motion, and allow the end of the nail plate holder to pass in between said jaws. Also, combining the nail plate holder with the arm, the rack bar, the spring, the pinion, the lever, the cam wheel, and the shaft, or their equivalents, in such a manner that the nail plate holder will be withdrawn at the moment that its semi-rotary movement commences, and will be pressed forwards at the moment that its semi-rotary movement ceases."

89. For an *Improved Method of Holding Vessels by the Keel in Dry and other Docks;* Jonathan Smith, Neponset Village, Massachusetts.

Claim.—"The arrangement of the keel pawl, as herein described; that is to say, a keel block which rests on and is confined to a bearer, and a pawl which slides in the straps or hasps, by which straps it is confined to the keel block and the bearer, a rope or chain attached to the pawl and led through a block to the side of the dock, by which the pawl can be hauled down; also, a rope attached to the pawl and led through a block to the side of the dock, by which the pawl may be raised."

90. For a *Shingle Machine;* John J. Speed, Jr., and John A. Bailey, Detroit, Michigan.

Claim.—"The combination of the reciprocating frames and feeding bar or catch, the reciprocating frames being provided with cutters, and the feeding bar or catch giving the shingles an accelerated motion while passing between the cutters."

91. For an *Improvement in Revolving Fans for Apartments;* L. Stein, City of N. Y.

Claim.—"Giving the combined revolving and flapping motion to the wings of a fan for cooling apartments, by having the wings hinged by one edge to arms projecting from a rotating shaft, and provided with crank arms, which, as the arms revolve, strike against fixed tappets or cams to give the flapping motion."

92. For an *Improved Clutch in Machines for Packing Flour;* Samuel Taggart, Indianapolis, Indiana.

Claim.—"The employment or use of the clutch formed of a cylinder or thimble, provided with a collar, and having studs or ribs on its inner periphery, which studs or ribs act against spiral flanches or ribs on the packing shaft, said cylinder or thimble having a constant rotating motion given it."

93. For an *Improvement in Life Preserving Seats;* Nathan Thompson, Jr., Williamsburgh, New York; patented in England, Sept. 18th, 1854.

Claim.—"The combination of adjustable buoyant bottoms with a buoyant top, whereby is constituted a life preserving seat."

94. For an *Improvement in Boot Crimping Machines;* Gray Utley, Chapel Hill, N. C.

Claim.—"The double row or series of independent and disconnected angular-shaped rubbers, placed opposite each other, and movable in horizontal guides to and from the centre, a spring behind each rubber effecting a gentle pressure upon the leather as it is pressed down between the rubbers by a crimping board, and each pair of rubbers retaining their pressure towards the centre, and from the edge of the crimping board upward, stretching the material until it shall have passed successively through the entire series."

95. For an *Improved Oven Cooking Range;* Daniel P. Weeks, Malden, Mass.

Claim.—"The arrangement and combination of flues, by which the smoke is carried around, and in contact with and made to heat the elevated oven of a cooking range, such causing the smoke to be led first against the rear half or portion of the under surface of the bottom plate of the oven, next against the front half or portion of the same, and in opposite directions to the two vertical sides of the oven, next upwards against the front half or portion of the external surface of each of the side plates of the oven, next downwards in contact with the remainder of each of the side plates of the oven, next into and upwards through a flue disposed directly against the rear surface of the rear end of the oven, and thence finally over and against the entire upper surface of the top plate of the oven, and thence through the discharge opening, the same enabling the oven not only to be thoroughly heated on its two sides, its bottom, top, and rear end, but to be so with a facility that insures quickness and strength of draft around it, whereby good combustion in the fire place is obtained and maintained."

96. For an *Improvement in Spring Bed Bottoms;* Wendall Wright, City of N. Y.

Claim.—"The manner of making the elastic bottom of bedsteads of wood, and in a

great number of square or other suitable shaped sections, in combination with the manner of arranging said sections."

97. For an *Improvement in Machines for Forging Horse Shoes;* Robert Griffiths, Alleghany City, and George Shield, Cincinnati, Ohio, Assignors to Robert Griffiths, Alleghany City, Pennsylvania.

Claim.—" 1st, The arrangement of the sliding former and rising griper, or their equivalents, operating so as to gripe the car both edgwise and flatwise at its mid length. 2d, The spring projecting plates or cheeks on the one side of the dies of the bending jaws, acting in connexion with the face plate of the sliding shearing apparatus on their other side, for the purpose of preventing the metal from bending laterally whilst being turned around the former. 3d, The channelled bending jaws, for the purpose of confining the outer margin of the shoe during the process of grooving and punching, the side of the shoe being supported by the convex shoulders of the male former. 4th, The arrangement of the bending jaws and swaging die, for the purpose of imparting the desired relative width and thickness at every part, and of clamping it when thus formed, whilst it is grooved and punched by a separate die working around the swaging die. 5th, The retaining of the shoe in the gripe of the bending jaws by means of the cams which operate them having a portion of their periphery, the arc of the circle described from their centre of motion, or the equivalents of these devices, until the grooving and punching bits and male former are withdrawn, in order that the shoe may drop freely the moment it is released from said jaws."

98. For an *Improvement in Grain and Grass Harvesters;* Wm. F. Ketchum, Assignor to Rufus L. Howard, Buffalo, New York.

Claim.—" The enlargement of the driving wheel, for the purpose of changing the mowing machine to a reaping machine."

99. For an *Improvement in Leather Splitting Machines;* Elisha Pratt, Assignor to self and H. P. Upton, Salem, Massachusetts.

Claim.—"1st, The use of rolls, composed of sections of rings strung upon a shaft, in combination with the springs, or their equivalent, and when they are so united with the shaft which carries them, that while they are permitted to rise and fall to accommodate themselves to the varying thickness of the leather, they are at the same time forced to revolve with the shaft, and feed the leather into the machine. 2d, The feed apron, non-elastic in the direction of its length, and elastic in the direction of its thickness."

100. For an *Improved Machine for Turning Prismatic Forms;* Melton Roberts, Assignor to self and H. E. Pierce, Belfast, Maine.

Claim.—" The machine for turning prismatic forms, consisting of the cylinder of cutters, the mechanism for rotating the block intermittently, and for giving the transverse motion to the revolving cylinder, the whole operating automatically."

101. For an *Improvement in Sewing Machines;* Allen B. Wilson, Watertown, Conn., Assignor to W. P. N. Fitzgerald, Washington, D. C.

Claim.—" The device in a sewing machine for feeding the cloth along, consisting of a bar furnished with points or notches having a vertical or up and down motion for fastening the cloth upon and releasing it from said bar, by striking it against a plate or spring, and a lateral motion, or motion forward and back for feeding the cloth along after each stitch."

Re-Issue for December, 1854.

1. For an *Improvement in Seed Planters;* Moses and Samuel Pennock, East Marlborough, Pa., original patent dated March 12th, 1841; re-issued October 30th, 1849; re-re-issue dated December 9th, 1854.

Claim.—" The construction of the seed drill with the hopper, when both are worked, or raised and lowered independently of the body of the machine, so that both may be thrown into and out of operation at the proper time by one and the same movement, or mechanical means."

DESIGN FOR DECEMBER, 1854.

1. For *Box Stoves;* J. Stewart, Assignor to Cresson, Stuart & Peterson, Baltimore, Md.
Claim.—"The design for box stoves, as illustrated."

JANUARY 2*nd*, 1855.

1. For an *Improvement in Machines for Boring, Planing, and Slotting Metals;* N. Aylsworth, Rochester, New York.

Claim.—"The so arranging of the several operative parts of a machine for turning, boring, and cutting key seats in car wheels, cranks, and other machinery, as that the three several operations may be completed from the same centres, without unchucking said piece of machinery, by which means more perfect work can be done than when the piece is removed or re-chucked for two or more successive operations."

2. For an *Improved Apparatus for Feeding Paper to Printing Presses and Ruling Machines;* David Baldwin, Godwinville, New Jersey.

Claim.—"1st, Feeding sheets of paper singly, or one at a time, to a printing press, paper ruling, or other machine requiring the feed of a single sheet at a time, by means of a vibrating frame having at its lower end a series of tubes, which, as the frame vibrates, passes over the sheet to be fed to the machine, and also over a portion of the cylinder, or other device for receiving the sheet; a vacuum being formed and destroyed in said tubes, by means of an air pump attached to the frame, for the purpose of causing the tubes to convey the sheets from the feed table to the receiving device of the machine. 2d, The self-adjusting feed table, constructed and arranged so as to be operated by the vibrations of the frame, and keep the sheets close to the ends of the tubes. 3d, The tubes, arranged on a vibrating frame, when said tubes, with the aid of an air pump, are employed for conveying the sheets to the presser machine."

3. For an *Improvement in Constructing Vessels;* William Ballard, City of New York.

Claim.—"The construction of the bows and the sterns of vessels, in an O G form."

4. For an *Improvement in Looms;* Abram Brigham, Manchester, New Hampshire.

Claim.—"The mode of locking together and adjusting two or more cams on one shaft, viz: by means of the convexities and concavities applied to them, as specified. Also, the combination of the movable or sliding tappet and the extra cam or lip with each other on the main cam, or its shaft, and the treadle."

5. For an *Improvement in Grain and Grass Harvesters;* John E. Brown and S. S. Bartlett, Woonsocket, Rhode Island.

Claim.—"1st, Hanging or hinging the bar to the carriage so as to vibrate, in combination with the hanging or hinging of the cutter stock to the bar, so that the cutter stock may vibrate and accommodate itself to any undulations in the surface of the ground, and so that it may be raised by the attendant to pass stones, stumps, or other obstructions, without tripping the carriage."

6. For a *Dove-Tailing Machine;* Thomas H. Burley, Cincinnati, Ohio.

Claim.—"1st, The inclined fronting guide, in combination with the oblique cutting edges of the saw teeth. 2d, The double inclined tables, in combination with the series of vertical chisels."

7. For an *Improvement in Grain and Grass Harvesters;* Marshall Burnett and Chas. Vander Woerd, Boston, Massachusetts.

Claim.—"Making the same shaft or axle which serves to drive the cutter rods, cutter, or cutters, serve also as the pivot or centre of the joint between the cutter bar and the carriage, thereby preserving the proper relation between the cutter or cutters, and their driving mechanism."

8. For an *Improvement in Locks for Fire Arms;* J. S. Butterfield, Philadelphia, Pa.

Claim.—"The combination of the sear with the cam, the latter operating in the slot of the main spring."

9. For an *Improved Trap for Catching Animals;* J. Caffrey, Paradise Township, Pa.

Claim.—" The peculiar arrangement and combination of the lever, spring, and wire grating, acting simultaneously with the revolving platform, to cause the trap to act and set itself."

10. For *Construction and Mode of Driving Circular Saws;* Thomas J. Flanders, Manchester, New Hampshire.

Claim.—" 1st, Supporting a circular saw edgewise, and operating it at the same time, by means of two spur gears, or their equivalents, arranged and operating at right angles to the saw, so that the said gears act upon the plate of the saw between the teeth, or through holes in the plate, to propel and support it edgewise at the same time, as described, thereby dispensing with the shaft, or its equivalent, heretofore used to propel and support the saw. 2d, Crimping or corrugating the plates of saws, so that they will require little or no setting, and to make them stiffer, also that the bends may run in contact with the sides of the score-cut, and support and steady themselves, so as to be less liable to be swerved by knotty, cross-grained, or hard places in the wood or material sawed, and at the same time run with less friction and power. 3d, Making the teeth of crimped or corrugated saws separate from the plate, and fastening them into the recesses formed by the crimping or corrugating, or between the bends in the plate of the saw, so that the saw may be supported and steadied by roller guides, or otherwise. 4th, Making the teeth of saws one-half the thickness of the plate or less, by taking off the side of the tooth, and the opposite side of the next tooth, as described, so that they will cut one-half or less than one-half the thickness of the saw kerf, so that the saw will run at a higher speed without heating, and execute a given quantity of work with two-thirds or less of the power heretofore required."

11. For an *Improvement in Churns;* Ezekiel Gore, Bennington, Vermont.

Claim.—" Making the pins with their inner ends flat, and so arranging them that they may be turned to the right or left, as desired, and thus made to present a large or small resisting surface to the agitated cream, and facilitate or retard the production of butter."

12. For an *Improvement in Machines for Cutting out Boot and Shoe Soles;* Jesse W. Hatch and Henry Churchill, Rochester, New York.

Claim.—" Giving the cutting knife or punch, half a revolution on its axis after every cutting operation, by any suitable mechanical means, for the purpose of reversing its position for the next cut, and thereby, when its ends are of unequal width, preventing the waste which, without some such provision, would be unavoidable."

13. For an *Improvement in Compensating Balances for Time Keepers;* Charles W. Hawkes, Boston, and George P. Reed, Waltham, Massachusetts.

Claim.—" The compensating lever, or its equivalent, in combination with the radial arms."

14. For an *Improved Apparatus for Atmospheric Pile Driving;* Alex. Holmstrom, City of New York.

Claim.—" 1st, Constructing the 'air lock' in such manner that the pressure of the air either within the lock or within the hollow pile may be governed by the workmen inside, whereby they are thus enabled wholly to control the means of escape for themselves. 2d, Combining with the air lock a hoisting apparatus, to which the moving power is given from the outside of the lock, but the application of that power to the windlass is made by the workmen within, whenever the same may be required, whereby those men are not only relieved from any extra exertion, but the ability is also maintained of applying greater force than could be done were the motive power given from within."

15. For an *Improvement in Railroad Chair Machines;* J. B. Harris, Cincinnati, O.

Claim.—" 1st, The holding plate and the leaf with the slots, and the block with the screws, in combination with the crank cutters. 2d, The cutter with salient cutting edges, thus making the cut concave in its length."

16. For an *Improvement in Cotton Gins;* Asa P. Keith, Bridgewater, Mass.

Claim.—" The slanting circular openings through the brush heads, with the guide flanches on the inside."

17. For an *Improvement in Machines for Forming Flanches on Wrought Iron Beams;* Julius H. Kroehl, City of New York.

Claim.—"The combination of the wide and narrow rollers and flanched rollers, which have a movement in the line of their axis corresponding with the desired form of the edges of the flanches on the beam, for the purpose of finishing or smoothing the said edges."

18. For *Cutters for Tonguing and Grooving;* Hazard Knowles, City of New York.

Claim.—"Forming, tonguing, and grooving cutter heads of combined disks of steel, which have cutting edges formed on their peripheries, of such a shape that new cutting edges can be formed upon them as the old wear away, without reducing their diameters."

19. For an *Improvement in Machines for Forging Car Wheels;* Wesley M. Lee, City of New York.

Claim.—"Forming the face of the hammer die with flutes or projections, substantially as specified, when combined with the turning of the die or anvil during the operation of forging or swaging."

20. For an *Improvement in Constructing Pavements;* Jean Francois Le Moulnier, City of New York.

Claim.—"Effecting the thorough union of the asphalte compound, or any equivalent therefor, and stone, by heating the block of stone previously."

21. For a *Shingle Machine;* Adrian V. B. Orr, Steeleville, Pennsylvania.

Claim.—"1st, Constructing the frame or slide of the splitting knife with two faces, the one being the thickness of a shingle in advance of the other. 2d, The device of raising the shaving knife from the platform during its back motion, for the purpose of allowing room for the introduction of the piece to be shaved. 3d, Moving the hold-fast up and down by the means described, so as to have its use when wanted, and then removing it out of the way of the finished shingle in its descent."

22. For an *Improvement in Regulating the Size of Rooving;* Samuel Pearson, Jr., and William H. Gardner, Roxbury, Massachusetts.

Claim.—"The combination of the brake, (forced downwards by a spring, or its equivalent,) the brake wheel, the shafts, and the connecting gearing of such shafts, as applied to the draw rollers, and the gill or hackle belt."

23. For an *Improvement in Processes for Extracting Tannin from Leather;* Obadiah Rich, Cambridge, Massachusetts.

Claim.—"The process for the removal of tannic acid from leather, and the subsequent preparation of the skin for making glue, by the use of ammonia, potash, or soda, of which the soda is preferred as the cheapest."

24. For an *Improvement in Signal Flags;* Henry J. Rodgers, Baltimore, Maryland.

Claim.—"The square signal flag with diagonal symbols, so that the same flag shall answer for signals in a high wind and in a calm."

25. For a *Machine for Splitting Rattans into Strips;* S. Sawyer, Fitchburg, Mass.

Claim.—"A combination of mechanism for splitting the rattan into sectoral strips, and a mechanism for running annular or symmetrical strands therefrom. Also, a combination of mechanism for splitting a stick of rattan into sectoral or triangular parts or strips, and a mechanism for rounding and dressing or finishing either one or more such strips. Also, a combination of mechanism for splitting a rattan in sectoral parts or strips, a mechanism for removing or separating from such parts annular or symmetrical strands, and mechanism for rounding, reducing, or finishing either one or more or all of the triangular strips or parts of the pith or inside portion of the rattan."

26. For an *Improvement in Processes for Making Soap;* Richard A. Tilghman, Philadelphia, Pennsylvania.

Claim.—"The manufacturing of soap by subjecting a mixture of fatty matters and solution of carbonated alkalies to a high temperature and pressure."

27. For an *Improvement in Life Preserving Rafts;* F. Z. Tucker, Brooklyn, N. Y.

Claim.—"The manner of connecting such buoyant cylinders, by passing rods through

tubes at right angles, and secured by nuts, in connexion with the straps or bands, whereby I make a strong, convenient, and ever ready life preserving raft."

28. For an *Improvement in Process for Making India Rubber Cloth;* Henry G. Tyer and John Helm, New Brunswick, New Jersey.

Claim.—"The peculiar mode of preparing the uppers of boots and shoes."

29. For an *Improvement in Sheet Iron Blinds;* Wm. E. Ward, Port Chester, N. Y.

Claim.—"The manufacture of Venetian blinds of sheet metal, bent in the form and united in the manner specified."

30. For an *Improvement in Sewing Machines;* Daniel J. Ward, Newark, N. Jersey.

Claim.—"The sliding fork, with or without the bristles, to detach the thread from the sides of the needle, or from a guide to the loop, for the passage of the looper or shuttle."

31. For an *Improvement in Protecting Slides and Ways from Dust;* E. H. Foote, Hartford, Connecticut.

Claim.—"The combination of the flexible guards which inclose the ways of slides in machinery, with the cross-head and the clasps, or their equivalents."

32. For an *Improvement in Tanning Processes;* Rufus Keeler, Rochester, Assignor to Lewis C. England, City of New York.

Claim.—"The improved method of tanning leather by introducing oil into the tanning liquor, and effecting its incorporation with the leather, in combination with the tannin."

33. For a *Machine for Manufacturing Wooden Boxes;* Louis Koch, Assignor to Theodore Rincus, City of New York.

Claim.—"1st, The means of making different sized boxes on the same machine, by the mere change of the cams and the pulleys, corresponding to the size of boxes to be made. 2d, Cutting off the boxes when finished, by tools fastened to spindles, said spindles being attached to the tool holders, and worked by an arm fastened on the end of the spindles. 3d, The construction and application of the frames with cones, respectively attached, actuating through the arms, the spindles, and consequently the tool, said frames being worked by cams and levers. 4th, The arrangement and connexion of the supports, provided with shafts and ratchet wheels, between which latter the wood out of which the boxes are to made is held, said supports being worked by cams and levers for feeding the wood to the tools, and releasing the same 5th, The construction of the pulleys worked by cams and levers, as well as by weights, said pulleys, when connected, acting upon the upper shafts running in the supports for approaching the wood up to the tool holders, after the completion of each set of boxes."

34. For an *Improvement in Curtain Fixtures;* Peter H. Niles, Assignor to self and Jonathan A. Richards, Boston, Massachusetts.

Claim.—"Arranging the spring in that chamber of the bracket in which the body of the pulley slides. Also, so arranging the secondary or lesser chamber, *g*, with respect to the chamber, *e*, that the spring may extend into both chambers."

35. For an *Improvement in Composition for Unhairing Hides;* Andrew H. Ward, Jr., Assignor to self and Kirk Boolt, Boston, Massachusetts.

Claim.—"The application of a compound solution of carbonate and sulphate of soda, to hides and skins, for the purpose of loosening their hair, and preparing them for the reception of tannin."

36. For an *Improvement in Seed Planters;* Alexander Anderson, Markham, Canada.

Claim.—"The peculiar construction of my seed planter, by which the apertures are made to perform the double function of carrying a graduated amount of seed to the discharge spout, and also to receive the teeth of the wheel, by which motion is communicated to the endless apron."

37. For an *Improvement in Self-Sealing Preserve Cans;* R. Arthur, Washington, D.C.

Claim.—"A vessel made with a groove to surround its mouth, prepared with cement, and ready for hermetical sealing; but to hermetical sealing itself I make no claim."

38. For an *Improvement in Journal Boxes for Carriages;* S. B. Bachelor, Lowville, New York.

Claim.—"The mode of constructing the stationary inseparable united recess in the pipe, in combination with the single adjustable axle shoulder band and sand band, with the cap and screw, or in any other manner substantially the same, by which I am enabled to use any axle of the common manufacture."

39. For an *Improvement in Suspended Purchases;* Wm. H. Brown, Erie, Pennsylvania; patented in England, October 2d, 1854.

Claim.—"In combination with a permanently suspended cable, a carriage provided with suitable block and tackle, by which a suspended weight of any kind may be transported to any given point, and then lowered or raised, or by which it may be lowered or raised as it is transported, at pleasure. Also, in combination with a suspended cable, a trunk or carriage composed of a main wheel, guide wheels, and a flexible frame, so that the wheels may adjust themselves to the line of the catenary. Also, the automatically coupling and uncoupling of the blocks. Also, the system of equalizing beams, when combined with two, three, or more cables, for the purpose of evenly distributing the weight upon the several cables."

40. For an *Improvement in Teeth;* Sharpless Clayton, West Chester, Pennsylvania.

Claim.—"The dove-tail grooves formed in the base of the teeth, and the holes through the teeth, said groove and holes to be filled with pure tin, cadmium, or any other fusible metal, so as to form a dove-tail flanch and pins, for the purpose of securing the teeth and gums to metallic plates."

41. For an *Improvement in Apparatus for Stereotyping;* Willard Cowles, Washington, District of Columbia.

Claim.—"The use of furniture of an exact and proper height, for the purpose of forming a bed in and around the mould, on which to place the metallic casting frame, which gauges the size, form, and bevel of the stereotype plate, or which shall itself form a support on which bars are placed, for the purpose of being pressed into the mould and imbedded therein, thus taking the place of the frame. Also, the use of a frame placed upon a bed in and around the mould, or in its place, the use of bars pressed upon and into the mould. Also, the use of slips of metal, or other substance, for the purpose of dividing the plate into two or more pieces."

42. For an *Improvement in Ox Yokes;* Levi Dederick, Albany, New York.

Claim.—"The flanched thimble for securing the centre bolts of separate vibrating neck blocks from the upper side, and thus avoid perforating the wood on the underside which rests upon the neck of the ox."

43. For *Composition for Fuel;* St. John O'Doris, Philadelphia, Pennsylvania.

Claim.—"The formation of an artificial fuel, by the combination of street garbage with coal dust, coal ashes, saw dust, and coal tar, or other bituminous substance."

44. For an *Improvement in Fermenting Tuns for Beer;* Adolph Hammer, Phila., Pa.

Claim.—"The application and use of the adjustable cover and the conduit pipe, in combination with the tun, or any other suitable vessel."

45. For an *Improvement in Fire Proof Iron Buildings;* Emanuel Harmon, Washington, D. C.

Claim.—"The insulation of the skeleton frame work of iron buildings from the exterior and interior coverings of said frame work with their fastenings or attachments, by the interposition of a non-conducting substance, such as plaster of paris, soap stone, or felt, in combination with an air space, or sheets of plaster of paris, felt, or other incombustible non-conducting substance. Also, the above insulation, in combination with the entire filling up of the space between the said exterior and interior coverings or surfaces with any incombustible non-conducting substance."

46. For an *Improved Mode of Hanging the Knife in Planing Machines;* M. G. Hubbard, City of New York.

Claim.—"Hanging the first knife on arms projecting from the stock, horizontally or nearly so, by which it is attached to the frame."

47. For an *Improvement in Cultivators;* John Imel, Liberty, Indiana.

Claim.—"The curved and adjustable guard or fender hinged to a tongue supported upon running gear."

48. For an *Improvement in Machines for Cutting and Turning Slate;* Asa Keyes, Brattleborough, Vermont.

Claim.—"The combination of the cutters or hammers on the fly wheel with the circular dog, in direct contact with which each successive portion of the slate rests, to receive the blows of the cutter while the slate is fed up by a carriage on the ways."

49. For a *Machine for Blowing Blasts, &c.;* P. W. Mackenzie, Jersey City, N. J.

Claim.—"The use of the drum and blower, having centres eccentric to each other, the said blower being internal of the drum, and propelled by it. Also, the cylindrical adjustable packing for the arms of the blower, in combination with the drum and blower arms."

50. For an *Improvement in Steam Railroad Car Brakes;* Henry Miller, City of N. Y.

Claim.—" 1st, The arrangement of the cylinder, the pipe, and the branch pipe of each car, to wit: the pipe inclining downwards from each end of the car, and the branch pipe inclining downwards from the lowest point of the cylinder towards the point of junction with the said pipes, so that the condensed water may all run from the pipes and cylinder, and escape therefrom, or be conveyed into a suitable receptacle provided with proper means of escape. 2d, Encasing the piston rod with a flexible tube, which is attached at one end to the rod, and at the other to the cylinder head, and is kept extended so as not to be injured by the working of the rod, by means of a spiral spring surrounding the rod, which said spring assists in returning the piston and freeing the brakes after the steam or compressed air is shut off."

51. For an *Improvement in Fruit Dryers;* R. S. Morse, East Dixfield, Maine.

Claim.—"The constructing a portable fruit dryer of a series of trays, and a protecting roof, united to each other by hinging bars."

52. For an *Improvement in Elevating Scaffolds;* F. Rudolph, City of New York.

Claim.—"The arrangement and combination of the centre pole and the scaffold, the former being usually placed within, and the latter about the structure to be built, each of which may be elevated, as desired."

53. For an *Improvement in Rakes;* Emile Sirret, Buffalo, New York.

Claim.—" 1st, A revolving rake, having the head made in two sections. 2d, In combination with the same, the employment and arrangement of the jointed forked treadle."

54. For an *Improved Method of Hanging a Path-Finding Saw;* John A. Taplin, Fishkill, New York.

Claim.—" The pendulum block to support and guide the upper end of the saw."

55. For an *Improvement in Composition for Dressing Leather;* Cuno Werner, Philadelphia, Pennsylvania.

Claim.—"The use or employment of a compound for dressing leather, composed of a saturated infusion of oak bark, (or other substances affording tannin,) train or fish oil, rosin, hog's lard, and creosote."

56. For *Improvements in Cast Iron Pavements;* C. Warner, City of New York.

Claim.—"The bars, connected, sustained, and bound together by the keys or cross pieces."

57. For an *Improvement in Hats;* Wm. F. Warburton, Philadelphia, Penna.

Claim.—"Forming the rim of hats with corrugations, channels, or grooves, or other ridges, or other form, for imparting strength, softness, and elasticity to the rim, with less weight of felt, or other material, and a decreased quantity of stiffening substance of which it is composed than is ordinarily employed in forming rims, the said rims being previously, or at the same time such corrugations, grooves, or channels are formed, slightly raised or arched at the front and back parts immediately next the body or crown of the hat, and depressed or slightly curved downward at the sides, or not, as fancy or taste may dictate, to give them the proper brace or set."

58. For an *Improved Machine for Cutting Irregular Forms;* Warren Wadleigh, Hill, New Hampshire.

Claim.—" 1st, A reciprocating cutter with one or two edges, guided or governed by one or more patterns, so as to cut the rough blocks or pieces of wood or other material, into the form required. 2d, The wedges, or their equivalents, so constructed and arranged as to enable the operator to vary the distance between the pattern and the cutter bar while the machine is in motion."

59. For an *Improvement in Machines for Making Weavers' Harness;* J. S. Winsor, Providence, Rhode Island.

Claim.—" The mode of operation, by means of which each twine is formed in a loop, and the spool, or its equivalent, conveying such twine, carried through such loop to form a knot, and then the spool, or its equivalent, which carries the other twine passed through such loop, that the twine thus carried through may be griped therein when the knot is drawn tight, thus forming the eye of two twines with a knot in each griping the other twine. Also, the mode of operation for determining the size of the eyes by closing the knots on the two fingers, or their equivalents, whereby the knots are closed at the proper place on each twine, the two sides of each eye made of equal length, and any desired number of eyes of the same size. Also, in combination with the fingers, or their equivalents, on which the knots are closed, the discharger, or any equivalent therefor, by means of which the knots are discharged from the said fingers as they are drawn tight. Also, the combination with the mechanism for forming the knots, the employment of pincers, or any equivalent therefor, for holding the twine tight after the knots at each end of the eye have been closed, and during the operation of drawing the twine tight around the band. Also, the mode of operation, by means of which the twines are wrapped around the bands in succession, and formed each into a loop through which the spool, or its equivalent for carrying the twine is passed to effect the tie. Also, the mode of operation for forming what is termed the leese of the harness, by reversing the motion of the spools, or their equivalents, for carrying the twine, thus carrying the twine alternately on opposite sides of one beam. Also, the method of mounting the heddles as they are formed on the slats or rods above the machine, and attaching the bands to which the heddles are tied in the process of formation, to a sliding bar, or its equivalent, which is elevated as the heddles are formed. And, finally, the method of marking every nineteenth, or any other number of heddles, by means of the marker receiving motion."

60. For a *Sawing Machine;* Lysander Wright, Newark, New Jersey.

Claim.—" The two pulleys varying in size, the revolving guide block, the arrangement and combination of the guides, cross-head, hold-fast, and guide block, shoe, and screw, for the purpose of raising and lowering."

61. For a *Burglars' Alarm;* Daniel Wells, Philadelphia, Pennsylvania.

Claim.—" The radial arm with its projection, and the latch with its notched recess, for effecting the disengagement of the spring bolt on the movement of a door, or its equivalent."

62. For an *Improved Press for Printing Different Colors;* S. Brown, Syracuse, N. Y.

Claim.—" 1st, The employment or use of a series of platens, (two or more,) so that the form or type on said platens may be inked simultaneously with separate and distinct colors, and operated or pressed simultaneously against the sheet. 2d, The arrangement of the cam, bent levers, and arms which are connected to the bent levers, for the purpose of operating the movable bed or platen, ink roller, and fingers. 3d, Operating the fingers by means of the screw and revolving bar, whereby the fingers are made to convey the sheet to and from the platens."

63. For an *Improved Arrangement in Double Piston Steam Engines;* W. S. Burgess, Norristown, Pennsylvania.

Claim.—" Having two pistons placed within one cylinder, the pistons being attached to rods, or their equivalents, so as to be a requisite distance apart, and attaching the connecting rod directly to the rods, or their equivalents."

64. For an *Improved Chuck for Turning Elliptical Cylinders;* Pulaski S. Cahoon and S. F. Ross, La Grange, Missouri.

Claim.—" 1st, The arranging of the ring upon the sliding standard, and combining it with the lathe spindle by means of the slide. 2d, Arranging the slide between the face plate and standard, instead of attaching it to a ring situated back of the face plate."

65. For an *Improvement in Grinding Mills;* Amory Felton, Troy, New York.

Claim.—"The combination of the cylinder, concave, cap, and reciprocating teeth or fingers, the concave and cap being provided with spiral flanches."

66. For an *Improved Paint Brush;* Wm. Hicks, Steubenville, Ohio.

Claim.—"1st, The arrangement of the brush holder with the reservoir handle, regulating valve, end branch or feed, conveying the color on to the top of the brush. 2d, In combination with the self-feeding paint brush or pencil, the adjustable guide roller to facilitate the run of the brush in its desired course, and at a speed corresponding with a free flow and a continuous supply of color to and on the brush, and serving to form a rest at various angles of operation or hold of the brush; the said roller being arranged to run on the outside of the lateral spread or splay of the brush, and on the off side of it."

67. For an *Improved Printing Press;* Sidney Kelsey, Erie, Pennsylvania.

Claim.—"1st, Feeding or conveying the sheets to the form by having the carriage formed of two parts, and arranged so that the edge of the sheet may be grasped between the two parts of the carriage as it is moved between the platen and bed. 2d, The fly, operated by means of the pulley attached to the carriage by a cord, said pulley being hung on the shaft which is provided with a spring."

68. For an *Improvement in Folding Life Boats;* C. Locher, City of New York.

Claim.—"Connecting the folding ribs by means of a chain or chains being applied, to spread all the ribs at once, and when spread, to serve the purpose of keeping all in place."

69. For an *Improved Printing Press;* James Lewis, Prattville, New York.

Claim.—"1st, The employment or use of the fly. 2d, The combination of the fly, cylinder, and bed."

70. For an *Improvement in Padlocks;* Thomas Slaight, Newark, New Jersey.

Claim.—"1st, The employment or use of a dog, so that the pressure of the shackle upon it, when the end of said shackle is forced into the case, will throw the dog into the recess or notch in the shackle without the intervention or aid of a spring, or any other device. 2d, The combination of the dog, guard bar, with the stud, upon it and slotted tumblers."

71. For an *Improved Crank Connexion in Double Piston Steam Engines;* J. Smith, Cincinnati, Ohio.

Claim.—"The employment or use of two pistons, connected by a cross head or plate which has a slot through it, in which the crank of the shaft fits, whereby the pistons are directly connected to the crank, and a rotary motion given to the shaft without the intervention of the usual piston and connecting rods."

72. For an *Improved Brace for Piano Frames;* Dwight Gibbons, Assignor to Frederick Starr, Rochester, New York.

Claim.—"The making use of a diagonal brace, extending above the plate and strings."

73. For an *Improvement in Repeating Fire Arms;* Joshua Stevens, Chicopee Falls, Mass., Assignor to the Massachusetts Arms Company.

Claim.—"So combining the trigger, the hammer, and the mechanism for rotating the cylinder, that by a single pull on and during the back movement of the trigger, the hammer shall be discharged or set free from the trigger, (so as to fall on the nipple when the touch-hole of one charge chamber of the cylinder is in connexion with it,) and the cylinder subsequently rotated so as to bring up to the percussion nipple, or its equivalent, the touch-hole of the next chamber of the series thereof. And, in combination with the mechanism for turning the cylinder, and that for locking and unlocking it, I claim a cam pin, (projecting from the hammer,) or its equivalent, for preventing the cylinder from being unlocked, or for locking it in case the movement of the trigger is so rapid as to render the cylinder liable to be rotated before the charge fired by the action of the hammer has left its chamber. The arrangement and combination of the trigger and its spring, a rotary tumbler separate from the trigger, and moving on a separate pin or fulcrum, a turning mechanism of the cylinder, and the locking and unlocking mechanism thereof, by which arrangement and combination, during and by a back and forward movement of the trigger, the cylinder will be locked or unlocked, and have an inter-

mittent rotary motion imparted to it, and the cock or percussion hammer be actuated. Also, the bearer, x, or its equivalent, in combination with the turning lever, L, and the part or tumbler to which it is connected or jointed, and by which motion is imparted to the said turning lever."

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74. For an *Improved Propeller;* Charles De Bergue, Dowgate Hill, London, England; patented in England, April 6th, 1854.

Claim.—"An apparatus or blade, so oscillating or rocking in water, or other fluid, on a centre or axis worked to and fro, that each of its opposite sides shall alternately present a moving inclined face or surface to the fluid on which it acts, so as to force, displace, or propel the same, or a body floating thereon, such apparatus or blade working or rocking within a case or chamber through which the fluid acted upon is thereby caused to pass, or conversely in which the fluid is passing, may act on the blade."

75. For an *Improvement in Machines for Crushing and Pulverizing Ores;* Arnold Buffum, Perth Amboy, New Jersey.

Claim.—"The rocking action of the crusher, in combination with corrugations on the lower surface of the rocker, and corresponding corrugations on the upper surface of the bed plate."

76. For an *Improved Machine for Turning Irregular Forms;* William J. Casselman, Vernon, New York.

Claim.—"The particular mode of arranging and combining a pattern table, two or more work tables, a tracer, and a number of cutting tools to correspond with the number of work tables; that is to say, the work tables and pattern table being arranged with their axes in the same plane, and the tracer cutting tools and the levers which connect them being all attached in such a way to receive a carriage which has a movement in a direction perpendicular to the axis of the revolving tables, but parallel to the plane of the said axes, that the points of the cutters and tracer stand in the same plane, or in a plane near to and parallel with the plane of the axes of the tables, and will all bear at all times the same relation to each other, and to the pattern and work."

77. For an *Improvement in Candle Mould Machines;* L. C. Ashley, Troy, N. York.

Claim.—"1st, The apparatus for centering, cutting, and holding the candle wick, said apparatus being constructed of stationary and adjustable plates, with centering and cutting notches on the stationary plate, and holding or tightening notches on the adjustable table. 2d, The wick tightener for tightening the wicks."

78. For *Improvements in Machines for Making Nuts and Washers;* Robert Brayton, Buffalo, New York.

Claim.—"The arrangement of the forming box and case, secured by the plate to the thread block, operated by the piston in the cylinder, in their relation to the check, check-bars, punch, and die. 2d, The metallic plates, as arranged in the slides, in relation to the head block. 3d, The spring gauge bar, the same being to protect the bed die from the heat of the blank or nut bar, and also to gauge its feed."

79. For a *Stop Cock;* David A. B. Coffin, Lynn, Massachusetts.

Claim.—"The arrangement of a rocking lever, so that if turned either way by the hand, it will open the valve and be in such a position that when the hand is removed the valve will be free to close by the pressure of the spring. Also, the arrangement of the elastic packing, so that it will perform the two duties of packing the valve stem, and constantly pressing the valve towards its seat."

80. For an *Improvement in Torsion Pendulums for Time Pieces;* Aaron D. Crane, Newark, New Jersey.

Claim.—"The method of compensating the torsion pendulum, by so constructing it as that its weights may swing from the centre of their motion in the ratio of the increase of their speed, thus making all its vibrations isochronal."

81. For a *Mode of Arranging and Driving Circular Saws;* Wm. B. Emery, Albany, New York; ante-dated Nov. 13th, 1854.

Claim.—"The manner of arranging a saw mandrel and its attachments, so as to carry

the saw or other cutter through or along the stuff operated upon, while such stuff remains at rest, and the axis of the pulley driving the saw mandrel is caused to vibrate or swing, so as to be always at an equal distance from it, and also from its own driving pulley, for the purpose of preserving the proper tension of the belts. Also, the combination of the three axes with the frame and the guide."

82. For an *Improvement in Ratchet Wrenches;* C. G. Everett, Brooklyn, New York.

Claim.—"The employment of the application to a wrench, of a ratchet of such form and a sliding stop, acting to stop or set free the said ratchet at pleasure, when the wrench is used for tapping."

83. For a *Forcing Pump;* Gilbert G. Farnam, City of New York.

Claim.—"Arranging the two sets of induction and eduction valves of a double acting horizontal pump on two plates, secured one to the top and the other to the bottom of a water box, divided by a vertical partition into two compartments, one end of the horizontal cylinder being secured to one side of the said water box opposite one of the compartments, when this is combined with the connexion of the other compartment of the said water box with the opposite end of the cylinder, by means of a side pipe. Also, making the outer end of the bore of the cylinder of an enlarged diameter, with a ring fitted thereto, having a bore of the same diameter as the cylinder, and flaring or trumpet formed at the outer end, in combination, and as a means of inserting the piston made with conical leather packing rings."

84. For an *Improvement in Entry Lights;* Chas. W. Felt, Salem, Massachusetts.

Claim.—"The combination of the link connexion with the cock for gas, and the sliding tube around the wick tube, for oil or other liquid illuminating material."

85. For an *Improvement in Dredging Machines;* D. S. Howard, Lyonsdale, N. Y.

Claim.—"1st, Constructing the bucket with a truss bar across its bottom, which, in addition to stiffening the bottom of the bucket, serves as a guide to the latch and a fastening to the spring. 2d, Fastening or attaching the latch to the bucket by a lip on the rear end of the latch, entering an aperture of corresponding size in the bottom of the bucket, the latch being held in is place by a spring bearing on it at any point between the lip which forms its hinge or fulcrum, and the catch. 3d, Fastening the buckets to the chain by a bolt passing through the links of the chain between the joints and through the ears and hinges of the doors of the buckets at the upper end, and at the lower end by links or clay cutters, as the case may require, one end of which is fastened to the buckets, one on either side, the other end being secured to the chain by a bolt passing through the links between the joints thereof, whereby the chains are allowed to conform to the curve of the wheel whilst the buckets are suspended between them, without conforming to that curve, and whereby the buckets may be readily disengaged from the chains when out of order, and replaced with others. 4th, The side or clay cutters. 5th, The manner of raising the buckets and chains into their rest position for transportation from place to place, by the combination of the pulley purchase with the wheel and axle, when attached to a car that carries the upper flanch wheels over which the bucket chains work. 6th, The self-acting pawl and catch in combination, by which the pinion is thrown out of gear when the machinery from any cause is turned back. 7th, The manner of feeding by the feeding ways. 8th, The manner of feeding or winding the vessel ahead by an eccentric on the main, or any other revolving shaft operating the levers and pawls, in combination with the windlass; also, the combination of the pawl with the vibrating arms, whether in connexion with the other parts of this feed apparatus or not. 9th, The construction and arrangement of the anchors, in combination with the winding head on the counter shaft, whereby the vessel may be worked ahead, whether the elevating machinery is in operation or not, or during the time that the feeding ways are being drawn back preparatory to taking a fresh cut. 10th, The manner of constructing the cam or chain wheels, the face plates on the periphery of the wheel being of steel, and the cams removable so that they may be turned at pleasure."

86. For an *Improvement in Devices for Stoppers of Bottles;* J. Hanley, City of N. Y.

Claim.—"The making bottles so that the resistance of their contents shall bear laterally upon the cork or stoppler; also, the oblique position of the 'bridge.'"

87. For an *Improvement in Operating Slide Valves in Direct Action Engines;* George W. Hubbard and Wm. E. Conant, Brooklyn, New York.

Claim.—"Connecting the slide valve and its tappet rod in such a way as to allow

either a certain amount of motion independently of the other, and combining them with a steam cylinder, piston, slide valve, and cut-off."

88. For an *Improvement in Hop Extracting Apparatus;* A. Hammer, Philada., Pa.

Claim.—"The retaining vessel, constructed and arranged for the purpose of producing the extract from hops required in brewing malt liquors, using the boiling vessel, or any equivalent device, for the purpose of boiling the hops within the said retaining vessel."

89. For an *Improvement in Mash Machines;* A. Hammer, Philadelphia, Penna.

Claim.—"The application and use of the upper rake, when combined with a mash tun, so as to be rotated in an opposite direction to that of the usual rake thereof, and with a more rapid speed."

90. For a *Rotary Shingle Machine;* J. W. Hatcher, Columbia, Tennessee.

Claim.—"Taking the shingle snugly from an oblong feeder open at the top and bottom, and partially so in front, by cells cut in the wheel. Turning the shingle after one side has been shaved, by means of a cylinder with bars attached, acted upon by a lever and returned to its place by a spring, and throwing the shingle off the wheel by means of a spring lever, after both sides have been shaved. The machine itself, when fed with rifted shingles, shaving both sides and turning out the shingles complete."

91. For an *Improved Arrangement of Slide Valve and Exhaust Passage in Steam Engines;* William C. Hicks, Hartford, Connecticut.

Claim.—"The producing, by one slide valve and valve seat, of two or more exhaust passages from each end of the cylinder, for each induction or steam port."

92. For a *Self-Regulating Wind Mill;* Frank G. Johnson, Brooklyn, New York.

Claim.—"1st, The combining together of the hub or spoke wheel, the regulating wheel, and the break wheel. 2d, The combining together of the weighted levers, the hub or spoke wheel, and the regulating wheel."

93. For an *Improvement in Coke Ovens;* Guillaume Lambert, Mons, Belgium.

Claim.—"The manner of combining the ovens, by means of flues and passages, whereby the smoke and gaseous products generated in each during the earlier stages of the calcining process, is burned in the next, where the process is at a more advanced stage, and the whole of the products of the combustion of the combined ovens are returned under the first, or that in which the process is least advanced, to assist in heating the charge contained therein, and expedite the liberation of the volatile products."

94. For an *Improvement in Refrigerators;* Hugh L. McAvoy, Baltimore, Maryland.

Claim.—"The application of glass to the purpose of lining refrigerators. Also, glass in any form or thickness, enamelled porcelain, or any thing substantially the same."

95. For a *Rotary Planing and Matching Machine;* C. B. Morse, Rhinebeck, N. Y.

Claim.—"The combination and arrangement of the following mechanical elements for the purpose of preparing or reducing and tonguing plank or boards, whether in combination with planing or grooving the same, or not; that is, the adjustable cutter carriage carrying the reducing and tonguing cutters, graduating lever, segmental scale and scales, with the indicating apparatus, or their equivalents."

96. For an *Improvement in Re-working Hard Rubber Compounds;* Charles Morey, Paris, France.

Claim.—"1st, Forming or moulding scrapings, filings, dust, powder, or sheets of hard vulcanized india rubber into a compact solid mass, by means of a high degree of heat and pressure. 2d, The application of dust, powder, filings of hard vulcanized india rubber, for soldering or uniting hard vulcanized india rubber."

97. For a *Machine for Printing from Engraved Plates;* Robert Neale, County of Clermont, Ohio; patented in England, January 18, 1853.

Claim.—"The combined apparatus for inking, wiping, and polishing engraved plates used in copper and other plate printing, the same consisting, 1st, In the attachment of the engraved plate to an endless chain with which it revolves while undergoing the several processes of inking, wiping, polishing, and printing. 2d, In the bed plate with its movable plate holder, and its strips or bearers, as constructed. 3d, In the mode of

inking the plate so as to confine the ink to the engraved portion. 4th, In the mode of regulating the pressure of the wiping belt upon the plate. 5th, In the mode of keeping the polishers clean by an endless belt of cotton, or other proper cloth, itself kept in proper order by the application of whiting, or other suitable drying powder, and preserved from dust and grit by the action of the revolving brush."

98. For an *Improvement in Windlasses;* Olden Nichols, Lowell, Massachusetts.

Claim.—" 1st, The cylinder. 2d, The action and co-operation of one or more pawls with the cylinder, so arranged with this cylinder as to come in contact with and firmly hold the chain when passing either way over the top of this cylinder, which constitutes with the pawls, both the windlass and stopper. 3d, The combination of the cylinder pawls and the adjustable guides, all or either of them, for raising, stopping, and fleeting chain cables."

99. For an *Improvement in Grain Harvesters;* J. E. Newcomb, Whitehall, N. York.

Claim.—" Making the hinged apron extensible ; I claim the mode of keeping the scythe plate to the shear edges of the guides, said mode consisting in the employment of the grooved pressure plate or bar, and set screws."

100. For an *Improvement in Oscillating Engines;* John A. Reed, City of New York.

Claim.—" The arranging and placing the valves and steam ports on each side of the cylinder, and in combination therewith, so as to let the steam in on both sides of the cylinder at the same time at opposite points, so as that the steam from opposite points may meet in the cylinder, and so balance the pressure as to prevent that severe friction which is occasioned by letting the steam in on one side only of the cylinder at a time. Also, the trunnion bearing, made adjustable to the trunion by the set screws, and so arranged that the conical trunnions may be accurately adapted to the conical seat."

101. For an *Improvement in Machines for Kneading Dough;* John Louis Rolland, Paris, France ; patented in France, April 11th, 1851.

Claim.—" The use of open frames for kneading dough, composed alternately of long and short blades, projecting inwardly from the cross bars."

102. For an *Improved Carriage Cramp;* Samuel P. Sanford, Fall River, Mass.

Claim.—" Constructing the cramp with anti-friction rollers, said rollers being provided with flanches, and having such a position that the peripheries of the tires and the sides of the felloes of the front wheel will, when the front wheels are cramped, bear against the rollers."

103. For an *Improved Apparatus for Soldering Tin Cans;* William J. Stevenson, City of New York.

Claim.—" 1st, The manner of constructing the upper extremities of the jaws of the clamp, for the purpose of forming a groove or channel to receive a strip of solder, and confine it where its presence is required after being melted. 2d, The manner of interposing a strip of wood between the cold iron of the mandrel and the lap, forming the joint or seam of the can, for the purpose of preventing the solder being cooled too rapidly after it has been melted."

104. For an *Improvement in Life-Preserving Seats;* N. Thompson, Williamsburgh, N.Y.

Claim.—" The adapting or accommodating life preserving seat, whose components are a separated buoyant seat, a hinge, and a spring, combined with each other."

105. For a *Stave Jointer;* James W. Treadway, Crown Point, New York.

Claim.—" The curved bed plate upon which the stave is bent and held by clamps, when in combination with suitable devices, to allow it to rotate partially about a fixed axis, for the purpose of giving any degree of bevel to the joints, and for jointing both sides of the stave without its change of position on the bed plate."

106. For an *Improved Beef Spreader;* Frederick Tesh, Johnstown, Pennsylvania.

Claim.—" The construction of a spreader for beef of a stick and tongue, operated by a cog wheel and ratchet work."

107. For an *Improvement in Flouring Mills;* John L. Yule, New Orleans, La.

Claim.—" Adjusting the parallelism of the upper stone to the lower, by means of the swinging frame and pivots, the height of the lower stone being regulated by the step and

screws acting on the spindle, the said spindle having a boy to give the shake motion to the shoe by means of the arm and rod."

108. For a *Lathe for Turning Fancy Handles, &c.;* L. Wentworth, Burlington, Iowa.

Claim.—"1st, The mode of arranging and operating the cutters; that is to say, attaching them to arms which revolve with the mandrel, and are attached to collars which are allowed to slide upon the mandrel, but not permitted to run with it, and so guiding the said arms by the inclined slots and studs, or their equivalents, that the sliding movement of the collars upon the mandrel produced by cams or pattern wheels, will move the cutters to and from the centre of the work, for the purpose of turning mouldings or grooves at intervals, or giving an irregular profile to the article being turned. A saw, arranged as described, upon the lathe in a swinging gate, which is weighted opposite the saw, to throw the saw to an inoperative position, but which is tilted to throw the saw into operation at the proper time to cut off the finished articles from the stick, by means of a lever actuated by a wiper on a wheel, which is attached to one of the feed rolls, or otherwise so driven as to make one revolution while the stick moves the length of one of the articles to be turned."

109. For an *Improvement in Looms;* Joseph Welsh, Philadelphia, Pennsylvania.

Claim.—"In combination with the lay, the lever and cam, when arranged so that in every change of the shuttle-box the picker shall be released from contact with the shuttle by a positive motion."

110. For an *Improvement in Processes for Making Japanned Leather;* Hiram L. Hall, Beverly, Assignor to James C. Stimpson, Salem, Massachusetts.

Claim.—"The improvement in the process of manufacturing patent or japanned leather, which consists in applying to the leather the composition herein described, (prepared either with or without borax,) and then submitting it, with the varnish coatings thereon, to a high degree of heat, whereby the surface of the leather is so matured as not to be affected by any temperature or change of climate."

111. For an *Improvement in Machines for Forming Kettles from Metal Disks;* Lyman C. Camp, Berlin, Connecticut, Assignor to Phelps, Dodge & Co., City of N. Y.

Claim.—"The employment of a pair of rollers, in combination with a pair of clamps, or their equivalents, all arranged for the purpose of operating upon a disk of brass or other metal, to roll out the said disk from a certain distance all round its centre to its edges, and bend or draw the part so rolled to form an angle with the central part, and cause it to be distended radially or towards the edges, and to be contracted circumferentially, thereby forming the said disk by successive stages into a kettle or vessel, or other similar article, with conical or cylindrical sides, without employing a mould or form."

112. For an *Improvement in Manufacturing Metal Tubes;* Wm. Beasley, Smethwick, Assignor to self, J. and J. W. Brett, Westminster, and C. W. Tupper, London, England.

Claim.—"The forming of a metallic tube by winding a strip of metal spirally on a mandrel, and welding it by cross rolling."

113. For an *Improvement in Looms;* William Tongue, Philadelphia, Assignor to self and James Buckley, Ladsburyville, Pennsylvania.

Claim.—"The combination of the continuous cord with the pulleys and double pulleys, irrespective of the number of double pulleys, or pulleys, B, as these are intended to be increased or diminished, as the number of shreds wanted may require."

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114. For an *Improvement in Fire Arms;* Thomas H. Barlow, Lexington, Kentucky.

Claim.—"Constructing the chamber of the cannon nearly square, and winding, so as to give the projectile the motion and accuracy of the rifle ball."

115. For an *Improvement in Seed Planters;* Jarvis Case, Springfield, Ohio.

Claim.—"1st, The agitation of the seed slide, by means of a rocker, wire, and levers, for the purpose of filling the seed hole with an uniform amount of seed. 2d, The elastic cut-off plate, in combination with the brush."

116. For a *Water Metre;* John S. Barden, New Haven, Connecticut.

Claim.—"The two heads, being secured one to each end of the cylinder, by means of bolts in the form of , for the purpose of collecting all sediment that may be drawn into the cylinder through the passages, and is not thrown out, or the collection of sediment upon their sides deposited from the water itself, without which the machine would, in a short time, cease to operate. 2d, The two small pistons with the spiral springs attached, in combination with the guides and , the latches suspended from above by the hinged joints and the bumper attached, the latches falling of their own gravity. 3d, The construction of the valve suspended upon the two arms, in connexion with the hanger, the two boxes, the two spiral springs within the same, and resting upon the top of the said boxes, with the cross bar and screws for regulating the pressure of the valve; also, in having the cross bar and elliptic spring resting on the boxes themselves; and, finally, the entire combination of the above parts."

117. For an *Improvement in Sewing Machines;* Jotham F. Conant, City of N. York.

Claim.—"An endless rotary cloth feeder, in combination with a reciprocating needle or needles."

118. For a *Bench Plane;* William C. Hopper, Pittsburgh, Pennsylvania.

Claim.—"The constructing of planes with the chisel or bit set in front of its wedge, in combination with the use of a mouth-piece."

119. For an *Improvement in Fire Arms;* Edmund H. Graham, Biddeford, Maine.

Claim.—"So attaching the tubes or short barrels in which the charges are placed, to a revolving plate, as to admit of their being separately and successively elevated into a horizontal position, in a line with and so as to form a continuation of the gun barrel, while the others retain a vertical position. Also, the lever, arranged for elevating and lowering the tubes which hold the charges, and for cocking the gun."

120. For an *Improvement in Temples for Looms;* John H. Allen, Biddeford, Maine.

Claim.—"Arranging the turning joint of the temple about midway between the end of the shat of the inner jaw, in combination with applying the spring so that it shall rest at or near its middle against the adjusting screw, and at its end against the two arms from the said shaft, the same enabling me not only to nearly, if not entirely, balance the temple, and prevent it from undue pressure upon the cloth, but to obtain from the spring a double action on the shaft, or an action on each side of the turning joint, by which the advantages in operating the temple and preserving it in correct operation are attained."

121. For an *Improved Gold Washer and Amalgamator;* J. S. Addison, City of N. Y.

Claim.—"Placing a trunk above a box which forms a receptacle for the gold or other metal separated in the trunk, and which contains a proper quantity of quicksilver for amalgamating the said gold or metal, and also a water wheel which is driven by the entrance into the said box of the water which is to form the upward current in the trunk, for the purpose of giving motion to a scraper to agitate the quicksilver to promote amalgamation. 2d, The arrangement around the trunk into which the pulverized ore, quartz, &c., is fed, to meet an ascending current of water which flows through and over the trunk, of one or more troughs to contain quicksilver, and a corresponding number of overhanging rims situated above them, that the flow of water, ore, &c., over one rim falls into the middle of the quicksilver unto the trough below it, and keeps the same properly agitated to amalgamate with it the whole or some portion of the gold or metal contained in the overflow."

122. For an *Improvement in Plugs for Lubricating Axles;* Alfred C. Garratt, Hanover, Massachusetts.

Claim.—"The chambered screw plug, open at its lower end, and having a passage made through its side, and applied for removing the accumulated wheel grease."

123. For an *Improvement in Lamp Shades;* M. B. Dyott, Philadelphia, Penna.

Claim.—"The arrangement of the shade, shield, and wires, or their equivalents, with the intervening space for the protection of the shade."

124. For an *Improvement in Door Latch Locks;* John C. Kline, Pittsburgh, Penna.

Claim.—"The arrangement, in double key-holed right and left hand locks, of the

key tumbler with its noses or projections, in relation to the spring receiver and the shoulders of the bolt."

125. For an *Improvement in Ploughs;* Arnton Smith, Scottville, Illinois.

Claim.—"The manner of coupling plough 1 with plough 2, by means of hinged slide rods, bar, and rod, for the purpose of allowing each plough a somewhat free and independent motion, and yet bring the ploughs under the control of one hand of the ploughman, and in some degree control both ploughs."

126. For an *Improvement in Lime Kilns;* Samuel H. Robinson, Baltimore, Maryland.

Claim.—"The so arranging of a series of side kilns around a central kiln as that the waste heat from the former may be used for burning the limestone in the latter, whereby a great saving of fuel and labor is attained, a more regular disposition of the heat made available, and either of the surrounding kilns stopped off, cooled, and drawn, without interfering in the least with the others of the series."

127. For a *Moulding Machine;* George M. Ramsey, City of New York.

Claim.—"The automatic reversible feed, or its equivalent, whereby the two opposite sides of the same piece of stuff are worked by the double action of one cutter head by once passing the stuff to and through the machine. Also, the arrangement of the cone and fan."

128. For an *Improvement in Fire Arms;* Alonzo D. Perry, Newark, New Jersey.

Claim.—"The arrangement of the tube in the stock for containing the caps, and a spring to force them forward in a line radiating from the axis of motion of the turning breech, and placing the nipple also in a line radiating from the axis of motion of the breech, so that when the breech is opened to receive a charge, the nipple will be brought into the same radial line with the cap tube, so that the same spring which forces the caps forward in the tube may also force one of them upon the nipple, thus simplifying the mechanism for automatic capping. Also, the use of an eccentric, or its equivalent, in combination with the capping tube and nipple on the movable breech, for the purpose of forcing the caps to their proper place on the nipple as the breech is brought in line for the discharge. Also, pivoting the trigger to the lever for operating the breech, so that the trigger shall be carried in and out by said lever, and shall not be brought into a position to act upon the lock until the breech is in a line with the barrel."

129. For an *Improvement in Constructing Brake Blocks for Railroad Cars;* Lucius Paige, Cavendish, Vermont.

Claim.—"The shoe, and the socket or bearing thereof, and applying them, that the shoe may extend entirely through and out of the socket in opposite directions, and be capable of being moved up to the wheel as fast as occasion may require, until it, the shoe or rubber, is worn up or rendered unfit for further service."

130. For an *Improvement in Scales;* John L. McPherson, New Vienna, Ohio.

Claim.—"The concentric loaded rims, in combination with the attachment of the dish."

131. For an *Improvement in Sewing Machines;* H. B. Smith, Lowell, Mass.

Claim.—"A slit or fissure formed in a needle, so as to be opened by any proper pointed instrument, and the thread inserted in this fissure, and then moved near to one end of it, thereby removing the pointed instrument, the two elastic or spring sides of this fissure close together and pinch and hold the thread, so that the needle can be operated to sew a curved or straight seam, and a through and through or back stitch. 2d, The finger, so arranged and operated (on the arm, by means of the spiral spring, the ring to adjust this spring, and the stock, or otherwise,) as to draw the thread through the cloth, so as to draw up the stitch, and then let go of the thread by the revolving or moving of this finger, and the arm, or its equivalent."

132. For a *Moulding Machine;* C. B. Morse, Rhinebeck, New York.

Claim.—"Constructing the cutter heads of two flanched disks, with slots or openings through one of the disks, to admit of cutters being attached to the other part, and partially masked by the flanch of the perforated disk, in combination with cutters, in openings through the rims or flanches, and secured respectively to each disk, so as to present a cutting edge over the whole space caused by the opening or closing of said disks by

means of nuts and set screws, said combination favoring a current inward from the edges of the cutters to fill the partial vacuum formed in the interior of the head by the rotation of the same, thereby causing a speedy inward removal of the shavings from the cutters, and admitting of the double action of the same. Also, the adjustable shields, in combination with the feed rollers, for preventing the said rollers from lifting the piece operated upon against the cutters when the feed is not continuous, and the extremity of the piece reaches the roller."

133. For an *Improvement in Spring Balances;* E. P. Beckwith, New London, Conn.

Claim.—"The employment or use of the cylinder surrounding the spring balance, and divided into parts or graduated so that by the aid of the index rod, or its equivalent, not only the weight, but also the whole or aggregate cost of any article may be determined at a given price per pound."

134. For an *Improved Steering Apparatus;* Abijah R. Tewksbury, Boston, Mass.

Claim.—"Arranging the rudder head within a concentric or surrounding frame or case fastened to the deck, and applying on the top of the rudder head, and within the case, a driving shaft gearing, and one or more curved racks of internal cogs, the whole to be operated by a hand applied to turn the shaft, the said arrangement of parts rendering their combination not only exceedingly efficient and compact as a steering apparatus, but one wherein the lifting or raising of the rudder by a wave or sea is not liable to injuriously derange the machinery."

135. For *Improved Hand Truck;* Parley Hutchings, Norwich, Massachusetts.

Claim.—"The elevator, constructed and combined with a hand truck, whether operated by a windlass or any other device commonly employed for raising weights."

136. For an *Improvement in Grain and Grass Harvesters;* O. B. Judd, Little Falls, New York.

Claim.—"1st, The employment or use of the rotating cutters and stationary cutter. 2d, Attaching the connecting rod to the outer end of the sickle, for the purpose of being enabled to employ a long straight rod with a compact machine. 3d, Attaching the sickle bar to the finger bar by hinges, whereby the sickle and connecting rod are kept properly in place, and the sickle readily attached and detached from the machine."

137. For an *Improvement in Straw Cutters;* John A. Pitts, Buffalo, New York.

Claim.—"So combining the cutting wheel and bar as that the edges of the cutters must always pass the bar at a fixed adjustable distance, whether the tendency to force the cutters from the straw be great or not."

138. For a *Machine for Making Boxes of Paper;* R. L. Hawes, Worcester, Mass.

Claim.—"1st, The pasting apparatus, consisting of rollers working in the open bottoms of vessels containing paste, or other adhesive material, said rollers having cavities or cells to receive paste from the paste vessels, and transmitted to such parts of the roll or piece of paper, or other material, as may be necessary, as the paper passes between them before entering the machine. 2d, The employment of a series, consisting of any suitable number of moulds of proper form for the boxes, arranged so as to work radially, or nearly so, upon or within a revolving mould wheel outside a series of tables, in such a way that a piece of paper, or other thin material to form a box, is taken between each of the several moulds and their respective tables, and drawn between the edge of a projection and of a clamp, or edges attached to or forming part of the wheel, for the purpose of bending the paper up the sides of the mould, and thus forming three sides of the box. 3d, Attaching to the mould wheel between the moulds, a number of blades corresponding with the number of moulds, so arranged at equal distances apart and at equal distances from the axis of the wheel, that the distance between their cutting edges shall be equal to the required length of the paper to form the box, and that they are severally and successively caused, by the revolution of the mould wheel, to act in combination with a fixed knife suitably arranged in any way, and cut the paper or material from the roll in proper lengths to form the boxes. 4th, The clamps, arranged one at the side of each mould, and actuated and operating for the purpose of lapping the part of the paper or material over the mould, to form part of the fourth side of the box. 5th, The presser, arranged relatively to the mould wheel, and operating for laying down the edge of the part 37 of the paper or material, and confining it till the part 38 is lapped over it. 6th, The presser, arranged relatively to the mould wheel, and

operating to lap the part 38 of the paper or material over the part 37, to complete the fourth side of the box, and at the same time lap the part 40 over the end of the mould, to commence the end of the box. 7th, The levers, working as described, on or within a wheel, or its equivalent, which rotates with the mould wheel, and successively so operated, by coming in contact with a fixed tongue, or other fixed part of the machine during the revolution, that each at the proper time folds the part 41 of the paper or material, and laps it over one side of the part 40. 8th, The arm carrying the plate, by coming in contact with which, the part 42 of the paper or material is folded and lapped over the opposite side of the part 40, to that covered by the part 41, also carrying the plate 14, which is caused by the action of the studs on the wheel, or its equivalent, to be moved from the central shaft to lap the part 43 over the parts 40, 41, 42, and thus complete the formation of the bottom of the box. 9th, The stationary smoothing and pressing plate, to smooth and finish the bottom of the box by the revolution of the latter in contact with it. 10th, The arrangement and mode of operating the roller 44, to take the glue or adhesive material from a fixed trough, and distribute it over the bottom of the box, to prepare the same for sanding. 11th, The shears at the end of the table 61, along which the printed string of labels passes from the printing apparatus, in combination with the intermittent motion of the said printing apparatus, for the purpose of moving forward the labels at proper intervals, and cutting them off one by one, as required, to be presented to the boxes. 12th, The table, 71, attached to or supported above the sheer blade, so as to move with it for the purpose of receiving the cut label and applying it to the box. 13th, The arrangement and mode of operating the tongs, the said tongs being arranged so that each box will pass them after being completely formed, and being operated to move towards the mould wheel with open jaws, and to close upon the box when it is between them, so that the mould, by a movement in the direction of its length, may be withdrawn from the box, and then to move with closed jaws from the mould wheel, to carry the box to a trough or box of sand. 14th, The hook attached to one jaw of the nippers, and operated upon so that as the said jaws descend with the box towards the sand box, it throws up the mouth of the box to bring it to a nearly upright position, to dip the bottom in the sand. 15th, The rod to knock over the finished box from the sand box. 16th, The general arrangement and combination of the several portions of the machine, either with or without the labeling and sanding apparatuses, and their appendages."

139. For an *Improvement in Seed Planters;* Elijah Morgan, Morgantown, Virginia.

Claim.—"1st, The combination of the stationary protecting bar and the reciprocating feed bar, when the latter operates within a groove in the former. 2d, The combination of the V shaped forms of the bottom of the hopper and the bottom of the reciprocating bar, when said bar is provided with openings from both sides, which meet and vibrate over the holes in the bottom of the hopper."

140. For a *Stereoscopic Medallion;* John F. Mascher, Philadelphia, Pennsylvania.

Claim.—"Constructing a medallion or locket with two supplementary lids, containing each a lens, and arranged so as to fold within the picture lids, and in such relation to the same that upon being opened and properly adjusted, they shall cause the lenses to stand opposite said lids, and thereby convert the medallion into a stereoscope, said arrangement also rendering the medallion useful as a microscope and sun glass."

141. For an *Improvement in Moulds for Casting Projectiles;* Hezekiah Conant, Hartford, Connecticut.

Claim.—"The arrangement of moulds in the periphery of a wheel, combined with a stationary band, which also forms part of each mould."

142. For a *Lubricator for Steam Engines;* John Sutton, City of New York.

Claim.—"Arranging the passage or passages between the grease reservoir and forcing cylinder, so as to be opened and closed by the movement of a solid piston, thereby dispensing with a valve, or equivalent, either in the piston or in the said passages, and only requiring one valve or cock in the discharge passage."

143. For an *Improvement in Seed Planters;* Stephen L. Stockstill and P. H. Humes, Brandt, Ohio.

Claim.—"1st, The converging openings of the gauge board, enabling the graduation of the amount of feed without narrowing or circumscribing the passage with respect to

the size of grain, which is thus preserved from cutting or injury. 2d, The dividing ridge or flanch around the perimeter of the feed wheel at its mid-width, enabling the same wheel to 'score' two exactly equal rows, and at the same time serving to stir the grain, and to shift out of the way any tailings or other obstructions that would intercept the discharge. 3d, The beveled or flaring axial mortise through the feed wheel, preventing any unevenness of the axle from wabbling or clogging the wheel, or disturbing the feed."

144. For an *Improved Arrangement of Filtering Apparatus to Prevent Incrustation in Steam Boilers;* Gustavus Weissenborn, City of New York.

Claim.—"The arrangement of the exhaust chamber, girdled at its lower part by the cold water, with the basin, chamber, and filters."

145. For *Improved Dies for Making Bolts;* J. T. Willinarth, Northbridge, Mass.

Claim.—"The dies, constructed for the purpose of operating simultaneously upon both sides of the head."

146. For an *Improvement in the Mode of Connecting Pipes for Steam Brakes;* W. Wright, City of New York.

Claim.—"Providing each end of the several lengths of pipe for conveying the steam or compressed air under the cars with a valve, and an elastic or movable tongue applied so as to allow the valve to be closed by the pressure of the steam or air when the end of the pipe is disconnected, but to be caused to open the valve by the entrance of the end of the pipe into the mouth-piece of the connecting tube."

147. For an *Improved Building Block;* Elizabeth A. Messinger, Adm'rx., and Wm. Spencer, Adm'r., of the Estate of John A. Messinger, dec'd., Milwaukie, Assignors to Ambrose Foster, Portland, Wisconsin.

Claim.—"The building block herein described, the same composed of sand and lime, in the proportion of 12 parts of sand to 1 of lime, mixed together and pressed in moulds."

148. For *Improvements in Door Knobs;* William Leighton, Assignor to New England Glass Company, Cambridge, Massachusetts.

Claim.—"The hollow silvered knob, sealed up and protected."

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149. For an *Improvement in Hernial Trusses;* Wm. M. Bonwill, Camden, Delaware.

Claim.—"The combination of the peculiarly formed hoop with the umbilical pad and strap, for the purpose of preventing the movements of the body from displacing the pad in either umbilical or in inguinal hernia."

150. For an *Improved Gas Heater;* William F. Shaw, Boston, Massachusetts.

Claim.—"The arrangement and combination of the air pipe, the perforated distributor, the air chamber, the flue pipe, and its surrounding chamber of combustion, or reverberatory dome, provided with an outlet pipe at or near its lower end, the said reverberatory dome or chamber being made to operate in connexion with both the internal and external air ducts, and for burning the surplus volatile products."

151. For an *Improvement in Rollers for Corrugating Sheet Metal;* Solomon G. Booth, City of New York.

Claim.—"Making the swages and dies for forming beams of wrought iron of numerous thin sections, so that one, two, or more sections can be removed to produce beams of different forms, for the purpose of saving the expense and inconvenience of a multiplicity of pairs of swages and dies."

152. For a *Hay Making Machine;* George A. Brown, Middletown, Rhode Island.

Claim.—"The construction of a machine, in manner and form as described, applying the power directly from the driving wheels to the spreading apparatus, thus saving the loss of power caused by friction in a series of wheels, using coiled or spring teeth, and the application of such machine to the purpose of spreading and turning hay."

153. For an *Improved Instrument for Cutting out Stone;* H. J. Brunner, Nazareth, Pa.

Claim.—"Cutting out slate or other stone from quarries, by means of a cutter stock provided with cutters, and having a reciprocating motion given it by means of a toothed

wheel, in which pinions are made to gear alternately, in consequence of the arrangement of the teeth on the periphery of said wheel, said cutters having the proper feed motion given them by the pawls, ratchets, pinions, and racks, or other substantially equivalent device."

154. For an *Improvement in Rollers for Curtains;* Dexter H. Chamberlain and John Hartshorn, Boston, Massachusetts.

Claim.—"The manner of applying the spring to the curtain roller; that is, extending it axially entirely through the roller and its two journals, and affixing it to the roller and both its brackets, (or journals extended from and fastened to them,) such not only affording advantages which a long spring has over a short one, but also important facilities in applying the spring, or modifying its tension, as occasion may require."

155. For an *Improvement in Carriages;* Geo. R. Comstock, Manheim, New York.

Claim.—"The employment of fills, in combination with a pole, which pole has attached to it an elliptic spring capable of a motion around the pole, to which spring, as well as to the fills, the draft animals are to be attached by the harness. Also, the arrangement of the fills, by which the space between them can be enlarged or contracted, to adapt it to one or two horses, as may be required, the same to be effected by a right angled elbow on the rear end of each fill, having several bolt holes through which it can be bolted to the frame work of the carriage, the fill turning as on a pivot, in a loop attached to the outward extremity of the said frame work. Also, the combination of the united fills, pole, and elliptic spring, with a carriage."

156. For an *Improvement in Carriage Seats;* G. R. Comstock, Manheim, N. York.

Claim.—"I claim the method of adjusting the load carried in two wheeled vehicles, so as to keep the pressure upon the animal drawing the same equal or nearly so, whether the carriage be moving upon level or uneven ground, by shifting the seat or upper body backward or forward, using an axis with toothed quadrants operating upon toothed racks attached underneath said seat or body, (or by the use of any mechanical equivalent,) said axis being manœuvred by a lever which passes through the arm of the seat or upper body, the said mechanical apparatus being in combination with the carriage body and seat."

157. For an *Improvement in Looms;* James Eccles, Philadelphia, Pennsylvania.

Claim.—"Moving and holding the picker forward in movable shuttle boxes, for the purpose of stopping the shuttle thereby, and causing the picker, after having stopped the shuttle, to recede by the action of the lever and pin, or their equivalents."

158. For an *Improvement in Means for Holding Window Blinds;* Henry A. Frost, Worcester, Massachusetts.

Claim.—"The application to window blinds of a semi-circular spring rod, which may bear upon a wide staple beneath the blind, which acts upon it at all times, so that the blind may be retained in any desirable position."

159. For an *Improved Marquetry;* Louis Francis Groebl, Philadelphia, Penna.

Claim.—"The marquetry, in which the different pieces of which it is composed are firmly united at their adjoining edges."

160. For an *Improved Hot Air Furnace;* Michael Greenebaum, Chicago, Illinois.

Claim.—"The arrangements of the cylinder in the drum, in combination with the perforated partition and the pipes and valve, for the purpose of regulating and equalizing the radiation of heat of hot air furnaces."

161. For an *Improved Mill for Cutting and Grinding Vegetables;* William H. Harn, Carlisle, Pennsylvania.

Claim.—"A slicing or cutting apparatus, consisting of a cylinder armed with knives, and working in connexion with stationary knives, in combination with a crushing or grinding apparatus, the whole being so constructed as to slice the fruit or vegetables, and then crush or grind them in the same machine."

162. For a *Book Brace;* William Ives, Buffalo, New York.

Claim.—"The combining with the brace the pointed spring bolt and spurs. Also, the application of the adjustable slide or brace."

163. For an *Improvement in Lifting Jacks;* Samuel G. Jones, Fitzwater Town, Pa.

Claim.—"The peculiar manner in which I combine the main post, the sliding piece, and the bent lever, the fulcrum of the said lever being placed near the lower end of the main post, and its weight point adjustably connected with the sliding piece by means of the holes near the lower end of the said sliding piece, whilst the upper end of the same piece is adapted to slide within the loop formed on the upper end of the main post."

164. For an *Improvement in Rolling Iron Shutters;* Charles Mettam, City of N. Y.

Claim.—"Making the slats with an exterior protruding arch at their centre, combined with flat laps or bearings at their edges, the slats being arranged in relation to each other, and united together, as set forth, by which configuration the shutter may be rolled up in a less compass, the labor of rolling up reduced, and many other advantages obtained."

165. For an *Improvement in Metal Folding Machines;* D. Newton, Southington, Conn.

Claim.—"The application to folders (for sheet iron, tin, copper, &c.,) of three or more pairs of steel fingers, all of the same shape, one-half of which are fastened to the plate which turns the fold, and the other half secured in a hollow underneath the same, the whole acting together, thereby drawing and holding the plate firmly on the metal whilst the fold is turning. Also, the gauge attached to the plate, by which the width of the fold is regulated."

166. For an *Improvement in Machines for Washing Paper Stock;* H. W. Peaslee, Malden Bridge, New York; patented in England, Sep. 20, 1854.

Claim.—"The arrangement of the oblique curbs, in continuous succession, round the open discharge end of the revolving screen cylinder, and forming channels between them to conduct the stock continuously, as the cylinder rotates, beyond the discharge edge of the cylinder, when combined to operate together with elevating hooks within the cylinder, and serving to retain a copious supply of water in the cylinder, for the proper washing of the stock, and to check the run of the stock through the cylinder to a speed in accordance with the conveying action of the cylinder, or its elevating hooks, to insure the full and regular action of the hooks on the stock."

167. For an *Improvement in Fire Engines;* Albert W. Roberts, Hartford, Connecticut.

Claim.—"The arrangement of the valves of pumps for fire engines and other purposes. Also, the arrangement of the compound brake and levers."

168. For an *Improved Compound Rifling Machine;* E. K. Root, Hartford, Conn.

Claim.—"The method of giving the motion to the cutter stocks for giving the increasing twist, by means of the connecting rod, or its equivalent, turning on a fixed centre, and describing a circle at the point of its connexion with the cutter carriage, which moves in a tangent line. Also, combining a series of cutter spindles with the said connecting rod, or its equivalent, by means of a sliding rack connected with the said rod, and engaging pinions on the said spindle. Also, in combination with the mandrels that carry the barrels, the slide, and its appendages, to act upon and turn the mandrels, in combination with the dogs for locking and holding the barrels during the rifling operation, the said dogs being operated by the said slide. Also, the mode of operating the series of stops to insure an accurate adjustment of the series of cutters. And, finally, the adjustable crank pins for operating the cutter carriage, in combination with the mode of forming the connexion of the connecting rods with the carriage, by means of slides governed by adjusting geared screws, as a means of adapting the machine to the rifling of barrels of various lengths without the necessity of changing the relations of the mandrels and the stops for setting the cutters."

169. For an *Improved Apparatus for Supplying Furnaces with Pulverized Metal;* Eloy Schmitz, City of New York.

Claim.—"Arranging within the blast pipe of a furnace, or other fire place, another and smaller pipe or tube governed by valves, to admit and cut off the blast, when this is combined with the charging tube, also governed by a valve, so that when the blast is forcing the pulverized substance from the tube within the blast pipe, the blast shall be cut off from the charging tube, and when the charging tube is open for the liberation of

the charge, the blast shall be cut off by the valves below. Also, in combination with the above charging and discharging tubes governed by valves, the employment of a branch tube governed by a valve opening to the atmosphere, to prevent the pulverized substance from being held in the charging tube by any excess of pressure which may be due to the entrance of the blast during the time the valves of the discharging tube are opened. Also, in combination with the discharging and charging tubes, the employment of the conductor and the punch rod."

170. For an *Improvement in Feeding Mortising Machines;* R.P. Benton, Rochester, N.Y.

Claim.—"Feeding the stuff to be mortised to the cutter, by means of a rotating screw rod operating upon a slide, and an adjustable crank which gives a reciprocating motion to the slide, the above parts operating conjointly."

171. For an *Improved Compound Crowbar;* Isaac J. Cole, Piermont, New York.

Claim.—"The combination of two levers (one of them having a circular projection on its lower side,) with the head block."

172. For an *Improvement in Fastening Centre Bits;* Abel W. Streeter, Shelburne Falls, Massachusetts.

Claim.—"The stationary catch, in connexion with the cam or bearer."

173. For a *Lubricator for Steam Machinery;* John Sutton, City of New York.

Claim.—"1st, Arranging the cylinder and piston of the feeder within or in the bottom of the grease reservoir, with the cylinder opening directly into the reservoir, whereby the construction of the feeder is simplified, and it is rendered more compact, and provision is made for collecting the sediment within the reservoir. 2d, Constructing the feeder with a valve in the piston opening towards the discharge end of the cylinder, and a valve in the discharge end of the cylinder opening against and closing with the pressure of the steam or motive agent, whereby it is caused to be only necessary to move the piston once back and forth to charge and discharge the feeding cylinder, and the lubrication is effected more quickly, and with less trouble to the engineer."

174. For an *Improvement in Lanterns;* Lewis Hover, Jersey City, New Jersey.

Claim.—"The arrangement of the springs, hooks, and ledges, operated as a fastening to secure the base of the lantern to the other portion of the same."

175. For an *Improvement in Iron Window Blinds;* Henry Blakely, City of N. York.

Claim.—"The method of fastening the metal blinds or slats to the frame, by securing their ends, or the pivots on which they turn in the eyes, in such manner as will prevent the blinds from being taken out by any force applied to bend them, short of the breaking strength of the several parts."

176. For an *Improvement in Looms;* George Copeland, Lewistown, Maine.

Claim.—"1st, Placing the cams which operate the two sets of harness upon two shafts carried by opposite arms of lever beams, which are capable of rocking upon a fixed shaft, with which the cam shafts are geared, and from which they receive the motion relatively to each other, to change the operation of the harness. 2d, The method of securing the lever beams, to maintain the proper position of the cam shafts for one mode of operating the harness and changing their position for the other mode of operating, by means of a spring or springs, or equivalents, or hook and a disk, or equivalent, carrying a stud. 3d, Weaving the closed part of the fabric or bottom of the bag, giving the lever beams a continual rocking movement on the shaft, for the purpose of enabling them to be caught by the hook and secured in position for weaving the open part of the fabric, as soon as a sufficient length of closed part or bottom has been woven, and the hook escapes from the stud which holds it during the latter weaving operation. 4th, For the purpose of throwing and catching the two shuttles simultaneously, pivoting the shuttle boxes to the ends of the lay, so that they may, by a vibrating or swinging motion, move opposite to the upper or lower race-way, as required. 5th, The manner of operating the two shuttle boxes, so that both may move simultaneously to and from the position for throwing and catching the shuttles, by connecting both with a lever, which is arranged to work under the lay, and receives the required motion from a treadle and cam, or other analogous means. 6th, The slots in the bars which form the upper race-way, for the purpose of

enabling the weft thread, which is being carried through the warp, to draw directly or nearly so from the filling point of the cloth or fabric."

177. For an *Improvement in Cotton Seed Planters;* Isaac Williams and Isaac W. Bausman, Alleghany County, Pennsylvania.

Claim.—"The use and combination of two cylinders, placed one above the other, not in the hopper, but in the throat below the hopper, one furnished with a row of long teeth, and the other with a row of short teeth, the teeth on each cylinder being placed helically around it, for the purpose of separating and distributing or scattering the cotton seeds."

178. For an *Improvement in Repeating Cannon;* Samuel Huffman, Charlestown, Ill., Assignor to self and Dennis O. Hare, Washington, D. C.

Claim.—"1st, The movable forward section with its flanch, in combination with the revolving rear sections secured to the plate. 2d, The flanch, in combination with the projection on the plate. 3d, The jacket or cold water tank. 4th, The vent closer."

179. For an *Improvement in Buckets for Chain Pumps;* E. Morris, Burlington, N. J.

Claim.—"The combination and arrangement of the gum ring with the cone."

180. For a *Match Machine;* Leopold and Jos. Thomas, Alleghany City, Penna.

Claim.—"1st, The use of the sliding carriage with the feed rollers. 2d, The combination of sliding self-shoving head, levers, and plungers, for the purpose of packing the finished matches in boxes. 3d, The carrier wheel and roller for applying the phosphoric composition to the matches by machinery."

181. For an *Improvement in Paddle Wheels;* J. U. Wallis, Danville, New York.

Claim.—"1st, The attachment of the oblique paddle floats, each by one edge only, to opposite sides of a wheel, or its equivalent. 2d, Attaching the paddle floats to the wheel by hinge joints, for the purpose of enabling them to be adjusted at various degrees of obliquity by screws, and to adapt their position to the direction of the revolution of the wheel."

182. For an *Improvement in Oscillating Engines;* G. F. Wood, Ulysses, N. York.

Claim.—"The arrangement of the separate induction and eduction valves communicating with separate induction and eduction ports and passages through the two trunnions, and connected with the same lever, to move simultaneously, and the same distance for stopping or reversing the engine. Also, transmitting an oscillating motion from the cylinder to the valve lever, for the purpose of moving the valves for their ports to meet those of the cylinder trunnions, and thus cause a quick induction and eduction."

183. For an *Improvement in Hand Rails for Stairs;* J. M. Bull, Sidney, Ohio.

Claim.—"Joining a series of blocks of wood, or other material, together at such angles as will form any circle or curve that may be required, and secure the same together by means of a rod provided with a screw and nut at each end, or any other mechanical equivalent."

184. For an *Improved Fountain Pen;* Newell A. Prince, Brooklyn, New York.

Claim.—"The elastic spring, unfixed in the feeding tube, whether the said spring be placed under or above the pen, it being so placed that it is made to vibrate by the action of the pen in writing. 2d, The under recess formed by inserting the feeding tube in the lower end of the main reservoir tube, the said under recess acting as a receptacle of the ink which reflows when the point of the pen is turned upward. 3d, The combination of the conical part of the piston with a conical seat for the same in the screw cap, so that when the piston rod is drawn outward in charging the main reservoir tube with ink, the hole in the screw cap is closed ink and air tight."

MECHANICS, PHYSICS, AND CHEMISTRY.

On the Motion of Water through Pipes. By Henry Hennessy, M.R.I.A.*

A very elaborate series of experiments have been recently made at Paris, on the motion of water through pipes, by M. Darcy, director of the public water works of that city. A memoir detailing the methods of experiment, and the results obtained, having been submitted to the Academy of Sciences, a commission of inquiry was appointed, from which has emanated an extremely valuable report, drawn up by M. Morin, and published in the number of the *Comptes Rendus* which has been just received.

The utility of economizing and properly regulating the supply of water to towns and manufactories, is now so fully recognised—the industrial and social importance of any practical conclusions that may be drawn from well-conducted hydraulic experiments, so completely admitted—that it appears desirable to give the utmost publicity to these investigations.

The experimental and mathematical researches which have hitherto formed the basis for engineering calculations, have generally afforded but little information as to the influence of the condition of the interior surfaces of the pipes on the resistance to the flow of water. Partly resulting from this cause is the fact not unfrequently observed in connexion with great water works, that while the volume of water actually discharged through new cast iron pipes is generally greater than that deduced from scientific rules, as soon as the pipes have been some time in use, and that deposits have been formed in them, the state of things is entirely reversed.

One of the chief objects of M. Darcy's investigations being to clear up practical difficulties of this kind, he proceeded to make a series of experiments, in order to determine—

1. The influences of the state of the surfaces on the discharge.
2. The influence of the diameters of the pipes on the resistance.

He used pipes varying in diameter from the smallest ever used for practical purposes, to half a metre, or a little more than 1 ft. 7½ in. The pipes were also of different materials, some of drawn iron or lead, and some of iron coated with pitch, or of smooth glass, also cast iron pipes, some of them quite new, some old with deposits, and some old without deposits.

The experimental arrangements were such that the observer was able to measure the pressure or effectual head of water in the iron pipes at the origin of movement and at distances of 50 and 100 metres (164 and 328 feet) farther on. The differences would give the measure of the loss occasioned by the resistance of the surfaces.

The leaden pipes, which were 50 metres long, or more than twelve hundred times the diameter of the thickest employed, had the pressures measured at a distance of 25 metres. A similar arrangement was made in the glass tubes, which had nearly the same dimensions. The mean velocities obtained in these experiments varied from 0·03 metres to 5 or

* From the Lond. Civ. Eng. and Arch's. Jour. September, 1854.

6 metres per second; that is, from 1·18-inch to 16 feet 5 inches, or 19 feet $8\frac{1}{2}$ inches nearly; thus going even beyond the limits used in practice. The inclinations and diameters of the several pipes were carefully measured by the most approved methods.

The most important general result deduced from these experiments is, that the nature and state of the interior of the pipes exercise a considerable influence on the discharge.

It appears, for example, that compared with the formulæ of M. Prony, iron pipes coated with pitch give discharges greater than the calculated results, in the proportion of nearly 4 to 3; that glass gives similar results; but that in cast iron pipes, whose diameter had been only very slightly diminished by deposits, the velocities, and therefore the effective discharges, were decidedly less than the theoretical indications, while after a thorough scouring a perfect agreement became manifest.

The diameters of the pipes seemed also to exercise a more decided influence on the discharge than what had hitherto been assigned to them; for with small diameters the results were less than by the formulæ, while they were greater for large diameters. This influence of the diameters was probably overlooked, as suggested by M. Darcy, from the fortuitous compensation established between the resistance in very thin but smooth pipes, and those of considerable thickness but encumbered by deposits.

From a discussion of his experimental results, it follows that the law of resistance is generally expressed by the usual formula:

$$v^2 B + v A = R I$$

R being the mean radius or hydraulic mean depth, I the inclination of the tube due to the resistance, v the velocity of efflux, and A and B constants. But an exception to this law holds in the case of very thin tubes and low velocities, in which case the term B disappears, and the resistance is proportioned to the velocity simply. As might be expected, therefore, the diameter and the substances composing the different pipes have been found to influence the values of A and B, for these have been found to differ in tubes of the same dimensions but of different degrees of internal smoothness, and also in those which were equally smooth but with unequal radii.

In pipes containing much deposited matter, which is usual in those that have been some time in service, it appears from M. Darcy's experiments that the resistance (as admitted by several engineers) could be safely considered as simply proportional to the square of the velocity, thus simplifying practical calculations. These experiments being made with pressures so varied and so considerable, an admirable opportunity was afforded for testing the long admitted principle, that the resistance presented by the sides of a tube to the liquid passing through, is independent of the pressure of that liquid. It was found, for example, that where the head of water varied in the ratio of from about 55 feet 9 inches to 85 feet 4 inches, and again from about 72 feet to 131 feet, between the two parts of the pipe submitted to observation, the differences or losses of head have remained the same for both parts. Such decisive results completely confirm the important hydraulic principle just mentioned.

In order to determine the numerical values of the constants A and B in the formula,

$$v^2 \mathrm{B} + v \mathrm{A} = \mathrm{R\,I},$$

M. Morin objects very properly to the use of the method of least squares, as not only requiring very troublesome calculations, but also introducing into the results the influence of mere accidental anomalies, which such experiments sometimes present. He prefers a graphical representation of the actual results of experiments, as being more expeditious, and capable of rendering more palpable such accidental circumstances as may deviate from the usual law. M. Darcy has employed this method simultaneously with that of least squares, and has thus, in a great measure, obviated the imperfections of the latter. Observers in every department of physical science might profit by the hint of M. Morin, as to the successive employment of the two methods; by which, we presume, he means the application, first of the graphical method, so as to detect the accidental anomalies, and then, on their elimination, the application of the method of least squares to the purified results.

After determining the values of the constant coefficients for tubes of different materials and dimensions, M. Darcy has estimated, by the aid of his formulæ, the velocities corresponding to the different inclinations, and has compared them with the observed velocities. This comparison shows, that for all kinds of pipes, and for every diameter, as soon as the velocities attain a few décimètres,* the formula of resistance may be changed to

$$v^2 \mathrm{B}_1 = \mathrm{R\,I},$$

and this will be especially correct for pipes containing deposits; that is, for working pipes in their usual condition.

A comparison of the values obtained for the coefficient which determines the resistance in tubes differing but slightly in thickness, has shown that their different degrees of smoothness, and general condition of their internal surfaces, exercise very remarkable effects on the amount of that resistance. Thus, tubes of thin sheet iron coated with pitch, of clean cast iron, and of cast iron covered with deposits, each having in inches respectively the diameters, 7·717, 7·401, and 9·567, gave for B_1 values which varied proportionally from 1 to 1·5 and 3. This result shows, that in estimating the action of a series of pipes for water works, they should be always supposed to have arrived at the normal condition of being coated with more or less deposit, no matter how comparatively smooth they may be at the time of laying them down.

Having found by experiment that the resistance diminishes with an increase of diameter, M. Darcy sought the law of variation as some simple function of the diameter, and he has shown that B_1, in the formula last given, may be represented by two terms, one constant, and the other varying inversely with the diameter of the tube. The law thus becomes

$$\mathrm{R\,I} = v^2\left(a + \frac{b}{\mathrm{R}}\right)$$

* One decimetre = 3·93708 inches, not much less than 4 inches.

Or if L represent the length of the pipe and H the height due to the resistance,

$$H = v^2 \frac{L}{R}\left(a + \frac{b}{R}\right)$$

From a series of eight experiments with tubes of drawn and cast iron, sensibly of the same degree of smoothness, and with diameters varying from half a metre down to 0·122 metre, M. Darcy has obtained the following numerical values:—

$$a = \cdot 0000507, \quad b = \cdot 00000647.$$

When the values of R, L, and v are given in English feet—

$$a = \cdot 0000507, \quad b = \cdot 00002122.$$

The expression generally recognised among hydraulic engineers as equivalent to the foregoing, is given by Mr. Neville in the form,*

$$R\,I = v^2\left(a + \frac{b}{v^{\frac{1}{2}}}\right)$$

Where

$$a = \cdot 00005585, \quad b = \cdot 00006659.$$

On making use of these results a very satisfactory agreement was found with observation, so that it was possible to safely calculate the values of B_1 in the formula of $v^2\,B_1 = R\,I$, for all diameters, for every centimetre from the first up to 50, or half a metre, and also for every 5 centimetres up to a metre. By simple transformations of the preceding formulæ, which will readily occur to scientific readers, it is possible to obtain rules for calculating the inclination required for obtaining a given velocity with a certain diameter of pipe, or the converse problem of finding the velocity corresponding to a given inclination.

The variation of the coefficient of resistance, which must be taken into account for narrow pipes, is much less perceptible in those with diameters greater than from about 5 to 6 inches, and it may be considered, without inconvenience, as constant for all those of greater diameter.

M. Darcy has also turned his attention to another question connected with the motion of fluids in pipes, which, although comparatively unimportant for practical purposes, possesses much scientific interest. The point referred to, is the law of variation of velocity of the particles of fluid from the axis of a pipe where it is a maximum, to the surface where it is a minimum. With the aid of a small and very slender Pitot tube, of which one branch could be placed parallel to the axis of the pipe at different distances from that axis, and of a manometer giving the pressure exercised on the surface, he has determined the excess of pressure observed at the Pitot tube over that on the manometer, and by a special process, the velocity of the fluid acting on this tube, or some quantity proportional to the velocity. Comparing in this way, for different inclinations, the excess of velocities in the axis over the velocities at different distances therefrom with the square roots of the inclinations, it followed:—

1. That the ratio of this excess to the inclinations was constant.

* See 'Hydraulic Tables, Coefficients, and Formulæ,' by John Neville, C.E., M.R.I.A., County Surveyor of Louth.

2. That the ratio of this excess to the $\frac{3}{2}$ power of the distance of a moving particle from the axis was constant for the same inclination.

3. That the ratio K of the same excess to the product $r^{\frac{3}{2}}\sqrt{I}$, constant for the same pipe, varies from one pipe to another inversely as the radius, so that $\frac{K}{R}$ is constant.

It is hence easy to infer that the relation between the velocity V, of the particles situated in the axis of a pipe, with the velocity v, of those situated at a distance r, from the axis, is represented by

$$V - v = \frac{K r^{\frac{3}{2}} \sqrt{I}}{R}$$

Whence, if w represent the velocity of a particle at the surface of the pipe,

$$w = V - K\sqrt{R\,I};\ \text{or, } K\sqrt{I} = \frac{V - w}{\sqrt{R}}$$

Whence substituting, we obtain,

$$v = V - (V - w)\frac{r}{R}\sqrt{\frac{r}{R}}$$

From which the velocity of any particle may be obtained if the velocities in the axis and at the surface are known.

It finally appears that for the mean velocity u, M. Darcy has deduced the expression,

$$u = \frac{3v + 4w}{7}.$$

By comparing the results of experiments made with different pipes, M. Darcy has been led to conclude, that although the degree of smoothness of the interior of a pipe must influence the resistance, and consequently the mean velocity of the fluid, it does not affect the law of variation of velocities from the axis to the surface, which appears to depend on the viscosity or molecular condition of the liquid.

It seems that the conclusions at which M. Darcy has arrived relative to the coefficient of contraction have not been considered quite satisfactory. It appears from the theory established by M. Poncelet, that the coefficient in question is a function of that at the opening of the tube, which varies with the head of water, the dimensions of the orifices, and the velocity. It follows, therefore, that the coefficient of contraction at the origin of the pipes ought itself to vary with these quantities; but M. Darcy has obtained a constant coefficient, such as is generally admitted, and this only by a compensation of differences. We have very little doubt that a more correct result would have been obtained if he had employed in the discussion of his experiments, the graphical method in the peculiar way to which attention has been already directed.

Here we must conclude our account of these important researches, which we are glad to learn will be published in detail by the Academy of Sciences, in the '*Mémoires des Savants Etranges.*'—*Dublin Monthly Journ. of Industrial Progress.*

On the Progress of Naval Architecture and Steam Navigation.
By Mr. Scott Russell.*

It was mainly (the lecturer said) in respect to speed that the great improvements in the last twenty years had been made. Within that time, the principle and the means of gaining speed had become definitely known, and this Association had had a great deal to do with the establishment of that principle, which consisted mainly in the particular formation of the water-lines of the vessel. The old ships had a round, bluff, duck's-breast bow, with a sloping narrow stern. At length the idea was arrived at of making a boat with a bow, the water-lines of which should correspond with the wave of the sea itself, which should gently and gradually divide the particles of water, which would then give a quiet and easy passage to the vessel entering, whether propelled by steam or by sails, without resisting their progress, and heaping a mound of water before the bows, as in the case of the old bluff, round-built vessels. It seemed now to be universally admitted in Europe and in America, that if a ship-builder wanted to have a very easy and fast-going ship, he must give her bow, not the round convex line formerly adopted, but a fine, long, hollow line, such as the meeting might observe for themselves in all the recently built vessels. Practical men, when they desired to build a fast ship, saw that they must now no longer use the convex water-line, but they must build with a hollow water-line at the bow, and in this consisted the great revolution which had taken place during the last twenty years. Whereas, formerly, the broadest part of the vessel was only a third part from the bow, the broadest part was now nearer to the stern than to the bow in the proportion of two to three, so that the shape of the ship under the water was very nearly reversed. The ship out of the water might remain very nearly the same, but where she cut the water the lines were as he had described. It was on this principle that American clipper ships and English ships which happened to be very fast, were built, and upon which he would say, without fear of contradiction, every vessel, to gain anything like sixteen miles an hour, must be built. Now there was, in addition to this, another very important principle which had been discovered. That was the virtue of the length. It used to be a dogma, in the time of his pupilage, that no steamboat could ever, by any possibility, go faster than nine statute miles an hour. He was born and bred in that belief. Nine statute miles an hour was the creed of his instructor in ship-building. At that time they had very short vessels, and they endeavored, by putting enormous power in them, to compel them to go through the water whether they would or not. He remembered being present at the trial trip of a vessel, out of which had been taken 50-horse power engines, and engines of 70-horse power substituted. It was a most extraordinary fact, that she only gained something like a quarter of a knot an hour by that enormous addition to her power and fuel, because she had not sufficient length to go by any force at a high speed; and the more she was driven through the water, the greater was the resistance made by the water which she

* From the Lond. Prac. Mec. Jour., Dec., 1854.

raised before her. The principle was ascertained, that, if you wanted the particles of water to go out of the way of the vessel when going very fast, you must give the particles more time to do so. Now, this might appear a contradiction in terms, but the faster the vessel was to go through the water the more time must be allowed to the particles of water to give way. It was found that it was more easy to push a vessel with an elongated body through the water at a great speed, than the short vessels which had been in use. This was reduced to a regular principle, the result of which was, that it was now certain that twenty-four feet of length in the entrance lines of a vessel, would give eight miles an hour easily; to go at sixteen miles an hour, the entrance lines should be nearly 96 feet long. To give twenty-four miles an hour, the entrance should be 216 feet long, so that they could not expect to get twenty-four miles an hour until they had made up their minds to build ships something like 400 feet long. From all the experiments he had made, and had seen made, these facts were undoubted. The clipper ships and fast steamers had lengthened their bow-lines until they had got the necessary length for speed; and if those present looked at any vessel which had got the reputation of going sixteen miles an hour, he believed they would find that to be the fact. Indeed, he did not believe there was in existence a vessel shorter than 180 feet which could go sixteen miles an hour; and if there were any such vessel forced to go more than sixteen miles, it was at an expenditure of power which was perfectly preposterous. They would, therefore, perceive why such a large vessel as the *Himalaya* had such great speed. The *Himalaya* had a length of 350 feet, and should have the greatest speed for the smallest power of any merchant vessel hitherto. If, in a like manner, they looked at the large clipper ships of 2000 and 3000 tons burden now built, they would find that the principle was taken advantage of, and that their bows were elongated to a great length. But what else was being done? The owners of the clipper ships were finding out that, by the lengthening of the bow, and making the lines more hollow, they could reduce the sails and spars, and yet preserve their speed, finding that the ships could not do in the water what force of canvas could never alone accomplish. Like every truth, the shape of a vessel had been long since found out and lost again. The London wherry was built as perfectly upon the lines he had described, as if it had been mathematically constructed upon them. In India, the boats were made precisely upon that form, and they were the fastest boats in the world, as a class. The Turkish caiques had the same shape, and they were very fine vessels. In Spain, they had arrived by some means at a form not very different; and throughout the whole of the last war, the Spanish vessels were the best vessels, and the best England took. The smugglers, because they risked their necks upon the speed of their ships, quickly found out what shape was best; and some of the most beautiful ships that ever came in'o our possession in that way were built in that form. The Americans had made very early an experiment of the kind in steamboats. They lengthened their steamers at a very early period, and they now generally build upon this plan, and with the hollow lines. They had done wonders in this way, and he believed, in England, wonders were also being done. It was not easy to carry the elongating of

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the vessels much further in wooden ships, because they could not get timber large enough, and it was impossible to make it strong enough by joining; but he believed Professor Fairbairn had discovered the means of joining iron, so as to make it equal in strength to solid metal. Having alluded to the building of the *Great Western*, and subsequently of the *Great Britain*, and the prophetic doubts expressed at first regarding the fate of each, the speaker proceeded to describe the great vessel now being built by him upon the Thames, for the Eastern Steam Navigation Company, to trade with India and Australia. He showed how the difficulty of carrying coals, and having to stop for them, and buy them at high rates at St. Vincent and the Cape of Good Hope, and sometimes the Mauritius, created such an expense that no freights could cover; he showed how it became necessary to construct a vessel large enough to carry her own coals all the way. When, therefore, he told them that the vessel being constructed was expected to make the voyage to Australia in 30 days, carrying a sufficient freight, with 600 first class and 1000 second class passengers, having three large tiers of decks, 8 feet each in height—that she was 675 feet long, 83 feet beam, 60 feet deep—when he told them, that he had just measured St. George's Hall, and found that it would not fairly represent this ship, being only 169 feet, instead of 675 feet long—that up to the top of the hall it was only 82 feet high, and up to the spring of the arch about the height of the ship—that the breadth of St. George's Hall was only 77 feet, being 6 feet narrower than the hold of the ship, it would give them the nearest approximation he could convey to the size of the vessel. In reply to a question, he stated that the huge vessel which he had described would draw 20 feet when light, and 30 feet loaded.—*Proc. Brit. Association, Sept.* 22, 1854.

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*Purification of Coal Gas.**

Even those who insist on the comparative purity of our metropolitan gas have admitted, so far as regards one of the most obnoxious of its defilements, namely, sulphuret of carbon, not only that it *is* contaminated with this impurity, but that all endeavors to withdraw it, short of destruction of the gas itself as an illuminator, have hitherto been fruitless. It ought to afford the gas companies high gratification, therefore, to learn that it is positively asserted that this grand desideratum has at length been attained, and that the alleged means of withdrawing, not only the sulphuret of carbon, but at the same time the ammonia with which admittedly their gas is also contaminated, are so simple, so available, and so easily applied, that no new or expensive apparatus whatever is requisite in order to accomplish an end which will not only remove more than one constant source of mischief, but greatly enhance the illuminative power, and hence the value of their gas, and that, too, at a cost to themselves almost nominal. All that is necessary, it is stated, is to use strata of hydrated clay along with the lime usually employed in the purification of coal gas. The efficacy of this mode of purification has already been tested, it appears, at the Wakefield gas-works, on upwards of 3,000,000

* **From the London Builder, No. 585.**

cubic feet of gas. The discovery is a practical one, which, in fact, has been patented jointly by the chairman of the Wakefield Gas-works, Mr. W. Statter, and another gentleman, also resident at Wakefield, namely, the Rev. W. R. Bowditch.

Hydrated clay, like some few other interesting chemical substances, forms threefold combinations, and so, in this case, effects its purpose. It not only unites, it is said, with the ammonia of the gas as with a base, but at the same time with its sulphuret of carbon as with an acid, and thus removes both of these noxious impurities from the gas exposed to its influence. Its good offices are said to be not even limited to these; as, in alternation with the lime of the usual purifiers, it assists in removing tarry vapor and other impurities.

The illuminative power of the gas, moreover, is thus said to be positively increasable from 22 to 33½ per cent.

The following results are given as rather below than above the average of a considerable series of experiments :—

"Feb. 14th, 1854.—Gas made with one-seventh cannel coal:—Lime purification: 5 feet of gas burnt per hour gave light equal to 12¼ sperm candles. Clay purification: 5 feet of gas burnt per hour gave light equal to 15 sperm candles. Gain : Light of 55 candles per 100 feet of gas, or 100 feet clayed equal to 125 limed (nearly).

"March 2d and 3d.—No cannel coal used:—Lime purification : 5 feet of gas burnt per hour gave light equal to 11½ sperm candles. Clay purification : 5 feet of gas burnt per hour gave light equal to 15¼ sperm candles. Gain : Light of 75 candles per 100 feet of gas, or 100 feet clayed equal to 132½ feet limed."

On this point the patentees say :—

"An increase of light, ranging fron 1-4 to 1-5, is an improvement upon which most gas companies would have felicitated themselves had it, and *it only*, been attained by superior management, at a cost of no more than ½d. per 1000 cubic feet: the production of light is the object of gas manufacture, and the advantage just named may be expressed commercially as an increase of about ¼ of the article produced, at an expense of 1-40th of the cost of production—gas being assumed to cost 1s. 8d. per 1000 feet. Practice cannot but receive with gratitude the boon presented for acceptance by her parent Science.

Of course we are not blind to the circumstance that the patentees of this invention have a personal interest in giving as high a coloring as possible to the alleged advantages of their patented discovery. We merely quote their statements in order to show that it is not only the duty but the self-interest of the gas companies to look into this matter, and at least to give the proposed method a fair trial, since they acknowledge that the removal of sulphuret of carbon is a great desideratum which is yet to be realized. There is, moreover, we think, a high probability that there is little or no exaggeration in what is alleged. The result of the use of clay at Wakefield is distinctly stated to be uniformly successful, and to bear out all that is said of its value.

Clay or alumina is one of the cheapest and most abundant substances in nature. Its cost, therefore, is out of the question, even although no positive benefit in increased illuminative power were attainable by its use. The only expense to speak of in testing its utility will be the cost of license from the patentees, which will be as nothing when placed in competition with the alleged advantages. We feel more assured than ever, then, that the day is at hand when our metropolitan gas will indeed be so pure that it will find ready and extensive access to our pri-

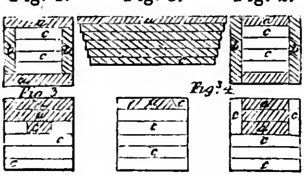
vate dwellings, and that the only points to be further urged to that desirable end will relate to the requisite general arrangements as to fittings and as to ventilation,—both of these points of great practical importance, to which we have repeatedly drawn attention, and on which we shall yet again, and very soon we hope, have more urgent reason than ever to dwell.

To John Davie Morries Stirling, *near Birmingham, for improvements in the manufacture of rails and parts of railways, and tyres of railway wheels.*—[Sealed 27th August, 1853.]*

This invention has for its object the piling certain descriptions of iron for the purpose of being rolled into bars, for the rails of railways, for switches and crossings of railways, and for tyres of railway wheels, and consists in piling bars of iron rendered crystalline by means of tin, antimony, arsenic, or bismuth, with bars of other iron (combined or not with zinc), to give fibrous character to the interior and other parts of such compound bars; the crystalline iron coming to the wearing surfaces.

Figures 1 and 2, show two piles of iron; the outer plates *a*, *a*, and *b*, *b*, being of that kind of iron known as "Stirling's patent hardened iron," and which is manufactured according to the improvements described under previous letters-patent granted to the present patentee. In the piles, fig. 1, the edges of the side plates *b*, *b*, are covered by the top and bottom plates *a*, *a*: whilst in fig. 2, this arrangement is reversed; the side plates *b*, *b*, covering the edges of the top and bottom plates *a*, *a*: the object being to enclose the more fibrous iron *c*, of which the interior of the piles is composed, with iron, hardened by the use of tin, antimony, arsenic, or bismuth, as is now well understood. The bars rolled from the piles, figs. 1 and 2, are intended for, and will be found very useful in, constructing the wing and point rails of railways. Figs. 3 and 4, show three forms of piles suitable for being rolled or formed into flanched or unflanched tyre-iron for railway wheels. In each of these cases the plates *a*, *a*, are of the patent hardened iron above mentioned, and the other plates *c*, *c*, are of the more fibrous iron. The number and thickness of the plates composing the piles may be varied, so long as the arrangement of the fibrous and crystalline iron is such as described. The patentee observes, that he prefers, for the more fibrous parts of each pile, to employ that description of iron which has been rendered more fibrous by the use of zinc, as described by him under former patents; but other fibrous iron may be used in place thereof. In making piles of fibrous and hardened iron, more especially when intended for tyres, it is recommended to pile the iron so that the bar or bars, which are intended to form the wearing or flanched surface, should be made longer than the other bars of the pile, and that the pile should be constructed as is shown in

Fig. 1. Fig. 5. Fig. 2.



*From the Repertory of Patent Inventions, June, 1854.

fig. 5; care being taken by the workman that the projection of the upper bar or bars (if the pile be placed upon the smaller base) be not to such an extent as to endanger the burning of the projecting parts when in the furnace. It is also recommended that, where the hardened bar or bars, as above described, do not extend over the whole width of the pile, they be formed, as shown in fig. 4, narrower in the upper surface than on the lower; and that the outside bar or bars of fibrous or common iron, which form the remainder of the upper surface of the pile, shall have a corresponding angle, as shown.

The Iron Industry of the United States. Abridged from Prof. Wilson's *Special Report on the New York Industrial Exhibition.**

The duties of the commission confided to Professor Wilson's charge, comprised those classes having reference to "Raw Materials" and the industries immediately connected with them. To these were added the examination of the machines and implements used in agriculture, and of certain branches of manufacture in which chemical principles were directly involved. The most important of all the mineral industries,—certainly as far as commercial relations with this country are concerned,—is the iron industry, and to this his attention was especially directed.

The distribution of the various metallic minerals in the different States is somewhat irregular, the rarer metals, as gold, being found but in few localities; tin only to a limited extent, in one place; lead and copper, which are found generally associated together, and occurring to a greater or lesser extent in most of the States; while, happily for the country, iron is met with everywhere, in some places forming deposits of enormous magnitude, and in others, compensating for its diminished quantity by the richness of its ores.

The ores found in the States comprise every variety known in Europe, save, perhaps, that of our own country, the "blackband." Those principally used for smelting are the magnetic oxides, the hæmatites, and the clay carbonates of the coal measures; besides these, the "spathic," or "sparry carbonate," and the "oligist" or specular iron are used, but at present only to a limited extent. The magnetic oxides and the hæmatites are dispersed pretty generally throughout the whole extent of the Union, from Maine to Texas, and from the Atlantic sea-board to the States of the far west. The clay carbonates are associated with the coal measures lying west of the Appalachian chain. In general they are not so rich as those in our own country, but when mixed with the hydrated hæmatites, which are met with skirting the coal districts, these lean ores are very advantageously worked up. They are also found in considerable deposits on the Atlantic side of the mountain chain, in Philadelphia,† Maryland, Virginia, and North Carolina. The spathic ores are not met with to any great extent; they are found in different localities in Connecticut and in Vermont, and when worked in the old method with charcoal and the ordinary cold blast, they furnish iron of first-rate quality.

* From the Journal of the Society of Arts, No. 98. † [? Pennsylvania.]

The specular iron ores occur in the New England States, and in New York State to a limited extent; in the more distant States, both of the South and West,—Texas, Arkansas, Missouri, Iowa, and California, they are reported to be present in great abundance.

The very general distribution of iron ores throughout the Union, and the abundance of fuel which the natural forests everywhere readily supplied, gave facilities for the manufacture of iron, which in the early days of the industry was carried on in various parts of the States, and in many formed the only sources from which the inhabitants could obtain their scanty supplies. Possessing in common with the other States both of the raw materials,—the ores and the fuel,—the New England States, owing to the advanced education and general commercial energy of her people, led the way in identifying themselves with the new industry, by forming establishments where it was carried out on a more extensive scale. Gradually, however, the existence of mineral fuel in Pennsylvania gave an advantage to that State which soon showed itself by the rapid growth of her iron industry. This continued annually to increase, while the scarcity of fuel in the New England States rendered them less able to meet the increasing demands of the market which they themselves had principally created. In 1830, anthracite coal was successfully used in smelting ores, and when, some few years later, it was shown that the hot blast could be as advantageously applied to anthracite as to other furnaces, this State became at once the great centre of the industry, and speedily assumed the control of the home market. This position she has held up to the present time, and must hold it for some years to come, until the iron-making resources of the States west of the Alleghanies are sufficiently developed to enable them to compete in production with their more advanced neighbors.

These great resources are as yet but very imperfectly known; geological investigations have long ago made known the existence of beds of fuel to a boundless extent, and so disposed as to offer natural facilities for working which cannot be without their results on the industrial uses to which they are applied. With these beds are associated, probably throughout the greater part of their area, beds of ironstone similar to that which we find in the coal measures of our own country. These give to this region a material advantage over that east of the mountain range, where the coal formation is entirely destitute of the ore beds which seem to be so bountifully distributed throughout the great bituminous coal-field on the western side. Thus while the smelting furnace in the one district finds a ready supply of both ore and fuel immediately at hand, the location of the other has to be determined by calculations based upon the comparative cost, and other circumstances attendant upon the transport to the furnace of the two necessary materials, the fuel and the ores.

The manufacture of iron has hitherto distributed itself on the line of the great rivers, which are the natural feeders to the canals by whose medium the produce has been conveyed to the consuming districts. Thus we find the chief seats of the iron manufacture to be:—1. On the Housatonic river traversing the State of Connecticut. The production of this district is limited to charcoal iron, of the best quality, obtained from the hæmatite scattered along the shores of the river. Spathic iron ore has

recently been discovered at Roxburg and Munro. The make of this division is consumed chiefly in the immediate district. 2. On the Hudson river, traversing the State of New York, in a line nearly parallel to the former river. On this line a large production of iron by anthracite coal, which is delivered at an average rate of 3 dollars 50 cents per ton, is rapidly springing up. The rich magnetic iron ores (iron 71·79, oxygen 28·21) which are traced for miles along the western sides of Lake Champlain, yielding from 60 to 65 per cent. of metal on the furnace, can be mined and delivered to the coal on the Hudson at an average cost of 3 dollars per ton. On the Hudson there are six large anthracite furnaces, and on Lake Champlain three more; but in the latter district the chief production is with charcoal, the ore being made in a kind of Catalan forge or bloomery. 3. On the Delaware and Lehigh rivers, the former of which separates the State of New Jersey from Pennsylvania, and empties itself into the Atlantic at Cape May; and the latter joins the Delaware at Easton, about 270 miles up. The Lehigh leads straight up to the north-east extremity of the first great anthracite basin, known as the "Schuylkill." Easton is about equidistant from the anthracite coal-field of Pennsylvania and the primitive ore range of New Jersey, while all around, there are extensive beds of hæmatite, yielding about 40 per cent. of metal. The Trenton Iron Company at this place have three large furnaces in operation—two with a diameter of 20 feet, and one of 22 feet, —giving an average production of from 500 to 600 tons per week. On looking over the returns, which were liberally shown, some extraordinary runs were observable, amounting to upwards of 240 tons per week from the 20 feet furnace, and continuing at that rate for several weeks together. Higher up the river are the works of the Glendon Iron Company, containing four large blast furnaces. Here, in order to economise space in the engine house, the blowing cylinders are placed immediately over the steam cylinders of the engine, so that the same piston rods, by a reciprocating movement, work the two cylinders at the same time. At Catasauqua the first furnaces in the States for the use of anthracite iron were erected, and Mr. Crane, in the year 1837, here first successfully applied hot blast to anthracite in iron smelting. In all the works visited economy of production was strictly adhered to. The air was heated by the waste gases of the furnaces, and in most cases the whole steam power, whether for driving the blast or for other purposes, was generated in boilers set in the upper part of the furnace, and arranged so that the heated gases played around them. 4. On the Schuylkill river, which runs into the Delaware a short distance below the city of Philadelphia, there are found, throughout the whole length of the valley, large deposits of hæmatite ores; these, however, are not so rich as those of the Lehigh; while the supply of the primitive oxides and carbonaceous ores is very scanty. Upon this river there are 18 blast furnaces using anthracite coal. Besides these, there are several small charcoal furnaces, whose fires are gradually waning away, though they still support the character of the American iron by the very excellent article produced. 5. The Susquehanna, another of the great parallel rivers running from the highlands of the interior down to the ocean, and which debouches, just below Havre-de-Grace, on the upper extremity of Chesapeake Bay, has along

its banks large deposits of iron ores. As it traverses the three large coal-fields, the Shamokin, the Schuylkill, and the Wyoming, and is well supplied with artificial modes of transport, it offers very great advantages in the manufacture of iron. 6. The Potomac, taking its course some 60 or 100 miles south of the Susquehanna, and running into Chesapeake Bay about midway from the ocean, is abundantly supplied with ores, chiefly hæmatites of good quality. Charcoal is the fuel chiefly used, although the increasing means of communication with the Cumberland coal-field, and also with the anthracite basins of the Susquehanna, have given great advantages in the way of fuel to those furnaces placed within reach of the lines of transport. 7. The Ohio, and the Cumberland and Tennessee, are still only partially developed, charcoal as fuel, and the hæmatite ores, which are found on the outskirts of the great Appalachian coal-field, being the sources from which the principal portion of the iron is now produced. In the upper part of the Ohio, in the Pittsburg district, more progress has been made; the furnaces are being worked with raw bituminous coal, and with the clay carbonates mixed with hæmatites. Limestone is also found in the immediate vicinity. Besides the production of these eight principal iron districts, a large quantity is made in widely dispersed localities, with charcoal as fuel, in small blast furnaces, or in the primitive forges or bloomeries. The gross amount of iron produced in the several States of the Union for the year 1850, as given in the Census returns, is 540,755 tons. The number of hands employed is given at 20,298, and the market value of the produce is estimated at 12,489,077 dollars. Taking the present production of pig iron at 800,000 tons, about one-half of it is consumed for castings, and the remaining portion is left to be converted into wrought iron, at a loss in waste, &c., of about one-third. This, for practical purposes, reduces the total or available production about 130,000 tons, and leaves in round numbers 700,000 tons to meet a consumption of not less than 1,200,000 tons. This deficiency must be supplied by the produce of other countries.

The number of establishments for the conversion of pig into wrought iron in the United States is given in the Treasury returns at 422. These establishments have an invested capital of between fourteen and fifteen million dollars, and give direct employment to upwards of 13,000 workmen. The total amount manufactured in the States may be taken at 500,000 tons per annum. In general, the wrought iron works are carried on as a distinct business from the manufacture of pig iron. The following establishments, however, combine the whole process of smelting and puddling: the Trenton Iron Company, at Easton and Trenton, New Jersey; Fuller and Lord, at Boonton, New Jersey; Reeves, Buck, and Co., Phœnixville, Pennsylvania; Reeves, Abbott, and Co., at Safe Harbour, Pennsylvania; the Montour Iron Company, Danville, Pennsylvania; and the Mount Savage Iron Company, Maryland. The principal cause of the separation of the two branches is probably due to inadequacy of capital to carry on both. Rolling mills for plate and bar iron are met with throughout the States in which iron is produced. In Pennsylvania the establishments for the conversion of cast into wrought iron are numerous. At one of the country rolling mills charcoal blooms were being used, which were first worked up in a puddling furnace, and then tilted; after

which they were again heated, and rolled out into plates of the required dimensions. Charcoal boiler plate fetches a higher price, and is always guarantied by the maker, as, owing sometimes to an imperfect process of reduction in the forge, a small portion of the fuel is left mixed up with the metal, and remains even after it has passed the puddling furnace and the tilt hammer. To detect the flaw in the iron when rolled out requires great care on the part of the foreman, who carefully notices, after it has left the rollers, whether the surface cools equally all over; if any black spots appear, they show that the plate is imperfect and contains cavities in which carbonaceous matter is usually found. The spots are then marked, and the plate laid aside. In the hands of the engineer they again undergo an examination; the practice of the boiler-makers being to rule them off in one-inch squares, and then test each square with the hammer, the expenses attending any unsoundness falling upon the maker.

A process, patented by James Renton, in 1851, for making wrought iron direct from the ore, is being carried out upon a commercial scale at Cincinnati, in Ohio, and at Newark, in New Jersey. At the former place the furnace was of a peculiar construction, resembling in shape an ordinary puddling furnace, at the extremity of which is a chamber of the following dimensions,—10 feet high by 6 feet broad, and 7 inches wide,—was built up in fire bricks, forming, in fact, a kind of large vertical muffle or retort; this was entirely surrounded on the sides by the flue or chimney of the furnace. When in operation, this muffle or retort is filled with a charge of ore and coal, both finely broken, and carefully mixed up together in the proportion of about 20 to 25 per cent. of coal, to 75 to 80 per cent. of ore. The muffle in question held a charge of 12 cwts. The heated gases from the furnace playing round it raise the temperature of its contents sufficiently to induce combustion of the carbonaceous matter, which is carried on slowly at the expense of the oxygen of the ore. When the ore is sufficiently deoxidized, it is discharged from the bottom of the muffle as required into the "welding furnace," where the heat is considerably increased, and the iron is readily worked up into balls, and thence taken to the hammer in the usual way. The iron by this process cannot be said to be puddled, as the ore never melts, but, having first been deoxidized in a close chamber, is simply welded together in what the patentee terms "an ore welding furnace." He appears to consider that the great merit of the process lies in the use of the closed chamber, in which the iron is perfectly protected from the wasting effect of the flame and gases of the furnace during the process of reduction, which would otherwise, as they always do, oxidize and slag the ores;—the probable reason why all attempts have failed to work the ores in open chambers. The temperature at which the deoxidizing action is carried on is not high enough to cause the iron to combine either with the carbon of the fuel, or with any of the impurities, as silica, phosphorus, &c., which are always found in common cast iron. The balls were drawn from the "welding furnace" for tilting every half-hour, their size depending upon the quality and yield of the ores that were being used. When the works were visited, a moderately rich hæmatite, yielding about 35 per cent. of metal, was being used, and the balls weighed about 80 lbs.

each. The average yield obtained, it was said, was 45 per cent., and the weight of the balls 100 lbs.

In the smelting furnaces (anthracite) the practice of economizing fuel by the application of the waste gases to raise the temperature of the blast, and also to generate the steam power necessary for the works, is carried out to a far greater extent than with us, and certainly merits a passing acknowledgment.

There is a very important labor saving machine in general use in most of the rolling mills, in the shape of a "*rotary squeezer*." This is fully as effective and much quicker in its operation than either the old hammer or the lever squeezer, termed the "alligator" in Wales; at the same time by its rotary action it saves the labor of turning the ball during the operation. The machine, though simple in construction, is necessarily made very heavy and strong to withstand the strain while at work. It consists of a fixed circular case in cast iron, with ribbed or fluted sides, surrounding a stout vertical ribbed roller, and eccentric to it, which is fixed on to a shaft and pinion, by which it is driven at high velocities. The ball is introduced into the "squeezer" at the widest part, and is rapidly carried round under an increasing (eccentric) pressure. The cap or top is made to move vertically, so as by its weight to accomplish the upsetting of the blooms ere they pass round. The invention is due to Mr. Burden, but has been subject to many close imitations, which have quite recently occupied the courts of law in the State of New York. At the Fall River Mills, a "rotary squeezer" (Winslow's patent) applies the same principle in a vertical instead of a horizontal direction. In this case a spring hammer is attached at the side, which strikes the ball at the end as it is passed through the squeezer.

The only other point of interest in connexion with this industry is the method of utilizing the slags of iron furnaces, which was illustrated by Dr. W. William Smith, of Philadelphia, in the New York Exhibition, in Class XXVII., where a collection of bottles, slabs, bricks, and other articles, run direct from the reducing furnace, were exhibited. The finish and appearance of the various articles would justify the expectation that the process, if applicable to the slags of coal furnaces generally, would be of great industrial importance. The price was about 4 c. per cubic foot for slabs.*

At present the United States is mainly dependent upon this country for its supply of steel. This circumstance is due entirely to the infancy and the undeveloped condition of its iron industry, inasmuch as the Ameri-

* Slag as a Material for Fictile Purposes.—Some time ago, Mr. Elliott, of Blisworth, made a very satisfactory attempt to establish the manufacture of bricks and tiles from the slag, or refuse cinder, of blast furnaces. Now, we have a further movement towards a similar end, at the hands of Dr. Smith, of Philadelphia, who, with a staff of chemical assistants, is at present engaged in the matter at Merthyr. His experiments have been made with the view of producing bottles, and domestic utensils of various kinds, as well as tiles and paving-flags; and this mode of converting the enormously accumulating cinder of the iron works has been decidedly successful. The new bottles are tougher and more perfect in their annealment than any of the ordinary glass kind; but they are undistinguishable from glass ones in external appearance. Lady Charlotte Guest has adopted the process, and it is believed that not much time will elapse before the transmutation of what has hitherto been a constantly increasing waste mass, will be a commercially valuable fact.—*The Practical Mechanics' Journal* for October.

can iron is in itself well adapted for conversion into steel, while in this country we are obliged to import our supply of steel iron from the north of Europe. The consumption of steel in the States has increased largely in the last ten years, and with the returning prosperity of the iron interests we find the establishments for the manufacture of steel increasing likewise. In 1840, the Treasury returns gave the importation of foreign steel at 44,506 cwts., and in 1850, at 127,517 cwts. The manufacture of steel is principally carried on in Pennsylvania; Philadelphia being the seat of the manufacture in the east, and Pittsburgh in the west.

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*Pendulum Test of the Earth's Mass.**

It has been known for some time that Professor Airey, the Astronomer-Royal, was engaged in scientifically investigating some important questions as to the density or mass of the earth, in Harton Colliery, on the banks of the Tyne. These experiments are now completed, although no detailed result has yet been arrived at, and we are, therefore, so far only in a position to explain the operations themselves. In connexion with this subject many of our readers will recall to mind, the *Schehallien* experiment of Dr. Maskelyne, made in the latter part of the last century; the *Cavendish* experiment, followed up by several foreign inquirers, and in this country by Baily; and, thirdly, a set of observations made by Mr. Airey and Dr. Whewell, in Dolcoath Mine, Cornwall, in 1826--28. These last experiments were precisely similar to those adopted at the present time in the Harton Colliery; but from some accidental causes, united with the great difficulty of ascending and descending the mine by perpendicular ladders, the observations were exceedingly doubtful. The adoption of galvanism in the regular routine of observation at the Royal Observatory, Greenwich, which forms a very important part in the present experiments, made the Astronomer-Royal anxious to repeat his former mining experiment, and Harton Colliery was selected for the purpose of again going into the matter; it is about two miles south of South Shields, and is well adapted for the purpose, being one of the deepest coal mines in the neighborhood. The lower station was 1260 feet below the surface of the earth. The observations consist in noting the vibrations of an invariable pendulum on the surface, and another at the bottom of the mine, both being mounted on firm iron stands in a manner similarly to each other. These pendulums hang on knife-edges, resting on agate planes, thus sustaining little resistance from friction. If swung in vacuo, the vibrations would probably continue for 24 hours; and in their state, as used, though liable to hindrance from atmospheric causes, yet the vibrations will continue at least eight or nine hours. Corrections are applied to the results for the effect of temperature, and also for buoyancy, or the effect produced by the pressure of the air on the pendulum. The vibrations are counted by the assistance of a clock, which is mounted immediately behind the detached pendulum, and thus, by the aid of a clock, the number of vibrations in a certain time can be easily noted. The method is simply this:—To the centre of the

* From the Lond. Prac. Mech. Jour., Dec. 1854.

bob of the clock pendulum is attached a small oval-shaped disk, covered with gold leaf, and illuminated by a lamp. It is necessary in the adjustments that this disk, when stationary, should be hid by the detached pendulum, and that there should be a slit in the clock case, which should also be just covered by it. A line, therefore, drawn through the centre of the telescope, which is placed at a little distance, through the detached pendulum, the slit in the clock case, and the illuminated disk on the clock pendulum, should be a straight line. Suppose the two pendulums set swinging, we should soon perceive that one was vibrating faster than the other, and that the disk would be gradually approaching the detached pendulum until it would be completely hid, and both pendulums would be going exactly together. This is called a coincidence, and is carefully noted to the nearest second of time. When the illuminated disk has re-appeared, which is generally in a few seconds, one pendulum will still continue gaining on the other until another coincidence takes place. The time is again noted, and thus we have the interval of coincidence, or the time occupied in one pendulum gaining two seconds over the other. The rate of one pendulum over the other is easily found, and, as this operation is performed simultaneously at the upper and lower stations, nothing remains but the comparison of the two clocks. In the Astronomer-Royal's former experiments in Cornwall, this was the most difficult part of the operation. At that time it was necessary to fasten the chronometers to the body by means of straps, and then to ascend or descend by perpendicular ladders—a journey which occupied considerably more than an hour in its accomplishment. In the present experiments this section of the observations is quite, if not more satisfactory than the observations of coincidences. This is owing to the adaption of galvanism to astronomical purposes, and by this means the comparison of the clocks is effected. A wire, properly coated with gutta percha, passes from one pole of the battery through a clock, which is so arranged as to push a spring, causing a galvanic circuit every 15 seconds. From the clock the wire passes through a galvanometer attached to the clock-case at the upper station, thence underground to the shaft, down which it descends to the lower station, where it passes through another galvanometer, also attached to the lower clock case. It then returns up the shaft to the other pole of the battery, and thus the circuit is completed. Signals were simultaneously observed by the observers at the upper and lower stations, which give a direct comparison of the two clocks. By this means we have every element for the determination of the gain or loss of the upper pendulum over the lower, and, consequently, the difference of the force of gravity acting on both pendulums is by calculation found. The observations extended over a period of three weeks, the pendulums remaining the first week in the same positions. In the second week they were reversed, so as to eliminate any error which may attach to either pendulum. In the third week they were reversed in the middle of the week. No result has yet been obtained, as the discussion of the large mass of observations will require considerable time and attention; but enough has been done to show that the observations are of a very superior character, and it is the Astronomer-Royal's opinion that most valuable results will be obtained from them.

The observers employed were selected from the principal observatories in England—Mr. Dunkin, of the Royal Observatory, Greenwich, who, in the absence of the Astronomer-Royal, had charge of the experiments; Mr. Ellis, also of the Royal Observatory; Mr. Pogson, of the Radcliffe Observatory, Oxford; Mr. Rumker, of the Durham Observatory; Mr. Criswick, of Cambridge Observatory; and Mr. Simmonds, of Mr. Carrington's private observatory, Redhill, Surrey.

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*Relative Fuel-value of Alcohol and Wood-spirit.**

Bolley has made some comparative experiments to ascertain this point. The wood-spirit used was slightly yellow and empyreumatic; the density was 0·81; it began to boil at 154°·4 Fahr., and then the boiling point rose gradually. It had a slight acid reaction, and the color became darker on the addition of caustic soda or sulphuric acid.

The alcohol had a density of 0·845.

The apparatus employed for these experiments consisted of a lamp for the combustion of the spirit, the burner being surrounded by a cylinder 8 inches in diameter, and a light brass pan supported above the flame for holding the water to be evaporated. Each experiment extended over about two hours. In each, the true quantity of water evaporated and quantity of spirit burnt were observed. The quantity of water, at 212° F., remaining in the pan was likewise observed, the quantity of steam that would have been produced by the heat thus consumed calculated, and added to the quantity of water evaporated. One fraction of the effect, the heat consumed in raising the water from 62° to 212°F., is not included in the table below:

		A. Consumption of fuel in grammes.	B. Evaporation of water in grammes.	Ratio of B to A.	Duration of experiment in minutes.
Wood-spirit,	1.	98	514°	5·25	101
	2.	133	697	5·25	149
	3.	124	597	4·81	138
	4.	198	782	3·95	165
Alcohol,	5.	160	680	4·25	104
	6.	178	781	4·39	148
	7.	133	590	4·43	119
	8.	159	687	4·32	170

In the experiments 1, 2, 3, and 6, 7, 8, the distance between the bottom of the pan and the level of the wick was always the same. In order to ascertain the influence of the greater elevation of the pan, it was raised in experiments 4 and 5 about three-quarters of an inch further from the flame. The result showed a loss in this case.

According to the first three and last three data, the heating capabilites of alcohol and wood-spirit are as 43 : 50, or nearly 6 : 7. The prices, however, were as 8 : 6; consequently, the cost of evaporating a given quantity of water by means of alcohol would amount to 56, while with wood-spirit it would be only 36; or wood-spirit, under such circumstances, would be nine-fourteenths cheaper fuel than alcohol.—*Schweizerisches Gewerbeblatt*, June, 1854.

* From the London Chemical Gazette, No. 295.

*Lightning Conductors.**

You have done me the favor to report what I said at Liverpool about lightning conductors. It is to me astonishing that the accounts of what passes in hasty conversation are so accurate as they are, and I should not have troubled you with anything like a correction, but that one or perhaps two slight errors in what I said, or ought to have said, has misled others. I did not say that I had been consulted about the application of a conductor to the Duke of York's pillar; but that when I inquired why it was affixed so as to be a great disfigurement to the erection, the parties who supplied it told me it had not been asked for until the column was completed. A little lower, the account says that certain contrivances for insulation are *absurd;* a better word would be *useless.*

M. Faraday.

Water Pipes.†

Mr. Waite, of Leeds, has patented water pipes formed internally of white delph, with a glazing like that of porcelain, and surrounded and compacted with a thick covering of a sort of concrete, forming a strong and impervious substance, it is said, not liable to decay, and as capable of resisting violence as iron pipes, and more economically produced. They are also said to be well adapted for gas pipes, and to be so air-tight as to prevent leakage.

Stand Pipe of the West Philadelphia Water Works.

To the Editor of the Franklin Institute Journal:

We noticed in the *Civil Engineer and Architects' Journal*, of September, 1854, page 33, a cut and description of the Stand Pipe for the 24th Ward. In this article, the design and working drawings are claimed by Mr. H. Howson, who was, for a short time, a draftsman employed by us, while the Stand Pipe was in progress of erection. This claim is entirely false and unfounded; the design was made before he was employed by us.

A lithograph of the Pipe was made for the Watering Committee of West Philadelphia, and extensively circulated, with our names appended as the Engineers. In this, the Pipe is represented as surmounted with a statue of "Washington," in place of the spire as it now is; the statue was placed upon the drawing at the suggestion of a member of the committee.

At the time the Stand Pipe was raised, notices were taken of it, and descriptions published in many of the papers of the day, in all of which our names only are mentioned. In *Gleason's Pictorial*, of March 26th, 1853, page 210, is published a cut and description of the Stand Pipe; in this our names only are mentioned. One of the lithographs was exhibited by us, as our design, at the monthly meeting of the Franklin Institute, May, 1853.

A large drawing of the Pipe was also exhibited (at the Exhibition of the Franklin Institute, in October, 1853,) by Mr. Howson himself, with our names as the Engineers; and in none of the above instances did he

* From the Lond. Builder, Nov. 1854. † Ibid.

advance any claim for the design; nor were we aware of his having made any claims until we saw the article in the *Civil Engineer and Architects' Journal.*

Had he made the design and working drawings, he could certainly have described the Stand Pipe with more accuracy than he has done. The following are some of his descriptions in the article above mentioned:

1*st.* He says, "a branch pipe of 12 ins. diameter, which communicates with the distributing main, passes through an opening in the masonry, through the main foundation plate, and is so connected to the cast iron base plate of the Stand Pipe that the water may have free ingress and egress." There are two mains of 16 inches diameter, one by which the water enters through the side at the bottom, another which passes through the bottom and up some distance in the Pipe, through which the water passes out.

2*d.* He says, "to the height of 36 feet above the ground, is built of cut stone." It is built of cut stone to the height of 32 feet 4 inches, and with stone faced with iron 4 feet 8 inches; in all, 37 feet.

3*d.* He says, "The projecting cornice at the upper portion, is 20 feet across." It is 19 feet 8 inches.

4*th.* He says, "The gothic door way is 8 feet high and 3 feet wide." It is 6 feet 10 inches high, and 2 feet 6 inches wide.

5*th.* He says, "The stairway terminating at an octangular landing 17 feet across." It is 16 feet.

6*th.* He says, "The plate iron spire is 9 feet 6 inches in height." It is 8 feet, and with the ball, 10 feet.

7*th.* He says, "The whole height, from the ground to the top of the spire, is 140 feet." It is 160 feet as the lot is to be graded, and 170 feet as it is now.

8*th.* He says, "The landing is 114 feet 8 inches." It is 115 feet.

We might mention many other mistakes, but these will suffice.

The modified valve gearing for the engines, to which he also lays claim, were adopted by us from drawings which we procured from England.

His claim for the design of the engines we are now constructing and erecting for the 24th Ward Water Works, is also false and unfounded.

We submit the above for your consideration, and hope we have not encroached too much upon your time or patience.

Very respectfully, yours,

BIRKINBINE & TROTTER.

P. S.—We understand that Mr. Howson has several affidavits sustaining his claim. We have made diligent inquiry to find who they are by, and can find none made by the parties who *only* could know anything about it.

We send you several of our affidavits, which you will please return when you are done with them. Yours, B. & T.

Remarks.—The affidavits referred to, appear to establish the fact that the design of the Stand Pipe was due to Mr. Birkinbine, and that Mr. Howson was merely employed with other draftsmen under his personal superintendence. EDITOR.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, February 15th, 1855.

John C. Cresson, President, in the chair.

John Agnew, Vice President,
John F. Frazer, Treasurer,
Isaac B. Garrigues, Rec. Sec., Present.

The minutes of the last meeting were read and approved.

A letter was read from the Philadelphia Society for the Promotion of Agriculture; the Circular of the Pennsylvania Commission to Universal Exhibition, Paris, 1855, was laid on the table.

Donations to the Library were received from the Royal Institution of Great Britain, and the Institute of Actuaries, London; Hon. Joseph R. Chandler, U. S. Congress; Prof. J. H. Alexander, Baltimore, Md.; the American Institute, City of New York; M. V. Baker, Esq., Pennsylvania Legislature, and Prof. J. C. Cresson, the Mine Hill and Schuylkill Haven Railroad Company, and the Philadelphia Society for the Promotion of Agriculture, Philadelphia.

Donation to the Cabinet from Dr. B. Howard Rand.

The periodicals received in exchange for the Journal of the Institute, were laid on the table.

The Treasurer read his statement of the receipts and payments for January.

The Board of Managers and Standing Committees reported their minutes.

The candidates for membership in the Institute (5), were proposed, and the candidates (10), proposed at the last meeting, were duly elected.

The Standing Committees for the ensuing year were appointed by the President, and approved as follows:

On the Library.

John Allen,
James H. Cresson,
George Erety,
Samuel B. Finch,
Raper Hoskins,
James Lukens,
Wm. S. Levering,
John P. Parke,
Clement W. Smith,
Thomas S. Stewart.

On Cabinet of Models.

Robert C. Cornelius,
James Dougherty,
Fred. DeB. Richards,
Edward P. Eastwick,
Geo. C. Howard,
Israel W. Morris, Jr.,
Chas. J. Shain,
William Smith,
Chas. Welsh,
Thomas F. Williams.

On Exhibitions.

John E. Addicks,
John Agnew,
Geo. W. Conarroe,
James H. Cresson,
Owen Evans,
Joseph Harrison,
Samuel V. Merrick,
John H. Towne,
Isaac S. Williams,
Thomas J. Weygandt.

Cabinet of Minerals and Geological Specimens.

Isaac H. Conrad,
John F. Frazer,
F. Augustus Genth,
John L. LeConte,
Angus N. Macpherson,
John S. Powel,
B. Howard Rand,
J. Hamilton Slack,
Laurence Turnbull,
John C. Trautwine.

On Meetings.

Washington Jones,
Daniel Leeds,
J. Vaughan Merrick,
Edward Mason,
Wm. C. McRea,
B. Howard Rand,
Fairman Rogers,
George W. Smith,
Marshall B. Smith,
Laurence Turnbull.

Cabinet of Arts and Manufactures.

James C. Booth,
Thomas Bickerton,
George M. Conarroe,
B. Barton Gumpert,
Wm. H. Hazzard,
J. Hall Rohrman,
Jas. M. Sommerville,
Wm. M. Uhler,
Thos. J. Weygandt,
John Wallace.

On Meteorology.

F. A. Bregy,	E. Otis Kendall,
Owen Evans,	Alfred L. Kennedy,
John F. Frazer,	James A. Meigs,
Laurence C. Francis,	Edward Parrish,
James A. Kirkpatrick,	George J. Ziegler.

Washington Jones exhibited the working model of a novel and very ingenious plan of gearing, designed to increase the speed of propeller shafts above those of their attached engines. The right to use the plan upon boats navigating the Delaware, has been purchased by a company, who are having an engine fitted with it to test its claims. It consists of a bevel wheel with internal teeth, into which works a bevel pinion. The wheel does not rotate, but is securely fastened to a base plate bolted to the bottom of the boat. The pinion is keyed on a shaft which is attached at one end, by a universal joint, to the engine shaft; the other end has a journal upon it working in a box fitted in a crank, of convenient length, keyed on the propeller shaft; the centre line of the pinion shaft, of course, forming an angle with the centre line of the engine and propeller shafts. The ratio of speeds is determined, not by the relative number of the teeth in wheel and pinion, but by their difference divided into the number of those in the pinion. For instance, the wheel in the model has thirty-three teeth; the pinion, thirty; difference, three; then, 3 : 30 : : 1 : 10. Motion being given to the engine shaft, and communicated to the pinion shaft by the universal joint, the pinion rolls round the wheel; being held in gear during its revolution by the rotation of the crank upon the end of the propeller shaft, which has motion given to it by the journal upon the end of the pinion shaft, and whose centre line falls in a plane passing through the centre line of the pinion shaft, and the point of contact of pitch lines of wheel and pinion. The pinion and its shaft performs the functions of a bent lever of the first order, the teeth of the wheel and pinion in contact being the fulcrum; the journal on the end of the shaft being the application to the weight. As, in levers of this order, the weight moves in a direction contrary to that of the power, it follows that the propeller shaft turns in a direction opposite to that of the engine shaft.

There may be, in the gearing itself, less friction than in the ordinary kind; but it is probably made about the same, if the whole machine be taken into consideration, for there is the extra friction on the pins of the universal joint, and the journal on the end of the pinion shaft. At high speeds there probably will be a vibratory motion resulting from the centrifugal force of the whirling mass; but, by a counter weight attached to the opposite side of the crank, it may be nearly if not entirely avoided.

An arrangement of this plan has been designed for horse powers; the pinion shaft standing vertically, and the fixed wheel lying in a horizontal position. It makes a very compact machine, with but few parts, and they not very liable to get out of repair, and is accessible on all sides.

Mr. Harrison exhibited a pair of light Russian overshoes or sandals. They have in the inside of the counter, a spring which secures the heel of the boot; this spring is released by pressing a small knob on the outside; they may thus be put on or off without touching them with the hand.

Mr. Harrison also exhibited a model of Wharton & Shiver's improvement in steam engines. The general feature of this machine consists in adopting the slot arrangement for changing the rectilinear motion of the piston to the rotative motion of the crank shaft, thereby dispensing with the connecting rod. This arrangement is already well known; the novel feature in the model exhibited is, in the peculiar shape of the slot, which, instead of being made with continuous straight and parallel sides, is made up of two slots parallel to each other, but not in the same line, connected together by a short angle, the centre of said angle being directly opposite the centre of the piston rod. In a revolution of the engine, the crank pin passing from half stroke towards the dead centre, moves in a direct line at right angles with the piston rod, until near the centre, when it enters the angle above alluded to, and quickly has its direction diverted obliquely, until it enters the straight slot on the other half of the stroke, at the end of which the movement is repeated for the remaining half revolution.

The value of the angle seems to consist in its causing the engine to commence its movement when directly in the dead point.

This invention is at present under consideration by the Committee on Science and the Arts.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on J. F. Mascher's Stereoscope.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, "an Improvement in Stereoscopes," invented by Mr. J. F. Mascher, of Philadelphia, Pennsylvania—Report:

That the instrument submitted by Mr. Mascher, consists of a light lid or flap fitted into a case similar to those commonly used for daguerreotype pictures, and containing two lenses of short focus, and fitted to the view of any stereoscopic pictures fitted permanently or temporarily into the case. The advantages presented by this very neat apparatus of Mr. Mascher are; 1st, That from its simplicity it can be made much more cheaply than almost any other form of stereoscope; 2d, That when in action it allows the light to fall upon the pictures at any required angle, and in any desirable quantity, there being no solid sides to interfere with the arrangement of the light. In these two respects it shares its advantages with a light and cheap form of instrument which has been for several years in use. But, 3d, Mr. Mascher's instrument is very compact, the bent frame folding down into the case, thus allowing a stereoscope daguerreotype to be kept with its proper lenses in the same case that is used for ordinary pictures; and the mobility of the lens frame by its rocking motion on its hinge, gives very greatly increased facility for the arrangement of the focal distance to suit any eyes, and for the other adjustment of the lenses for distinct vision.

In reference to the originality of the invention, it is sufficient to say

that Mr. Mascher has obtained Letters Patent for his invention, and of course, the only proper course to attack him on this point would be by taking means to obtain the decision of a court of law upon the point.

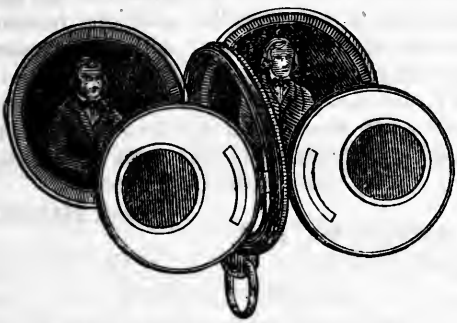
As this matter is not within the scope of the examinations of the Committee of Science and the Arts in such cases, they content themselves with recommending to general use, the stereoscope patented by Mr. Mascher, as being a very neat, cheap, durable, convenient, and easily adjusted instrument, superior, for ordinary purposes, to those forms commonly in use.

By order of the Committee,

Wm. Hamilton, *Actuary.*

Philadelphia, February 8th, 1855.

Since the adoption of the above report, Mr. Mascher has invented and submitted to the inspection of the members of the Institute, a stereoscope arranged in a locket of the usual form and size. The arrangement is illustrated by the accompanying wood-cut, and besides the convenience



of the size and mode of preserving the pictures, the lenses are made more powerful than those of other stereoscopes, and the pictures are thus more highly magnified. Ed.

Report on J. W. Queen's Microscope for Students.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, a "Microscope for Students," invented by Mr. James W. Queen, of Philadelphia, Pennsylvania—Report:

That in the instrument submitted by Mr. Queen to the Committee, nothing of originality is claimed, either in the optical or mechanical arrangements, but the endeavor has been to produce an instrument containing, as far as possible, all the best qualifications, with such cheapness as will render it accessible to a much greater number of persons than are now able to procure them, and thus to spread the habit of using this very valuable instrument.

The instrument examined by the Committee, has its tube of brass furnished with the usual lenses, so mounted upon a cast iron stand as to be capable of motion in the vertical plane, so as to be used either vertically or inclined, and carrying a well arranged platform for holding the objects.

It is likewise provided with a plain mirror and a separate condensing lens. The whole of the instrument, including the glass of the lenses, is of American material and manufacture.

The mechanical arrangements of the instrument are neat and efficient, and its movements are executed easily and with precision; it is substantially made, and of good workmanship, and its defining power is entirely satisfactory. It is, however, at present provided only with a single objective (1 inch focus,) and a single eye-piece; and although these are sufficient for examinations of a rough and popular character, and even available for many investigations into the structure of plants, yet they are altogether insufficient for the investigation required in physiology and pathology, and are therefore not fitted for the use of students in these sciences. For such persons the Committee would not recommend the use of any instruments which had not at least three objectives of $\frac{1}{2}$ inch, $\frac{1}{4}$-inch, and $\frac{1}{12}$-inch focal distance respectively, and the eye-pieces such that the highest power with the shortest objective should magnify at least six hundred diameters. The present instrument of Mr. Queen is sold for $25, and Mr. Q. believes that, with the additions recommended by the Committee, the cost of the instrument will not be more than $50·00 which the Committee regard as low for a good instrument with the above requisites. They, therefore, in acknowledging the merits of the instrument as at present made, recommend that the additional powers be added to it, when it will be justly entitled to the name of Student's Microscope.

By order of the Committee,

William Hamilton, *Actuary.*

Philadelphia, February 8th, 1855.

BIBLIOGRAPHICAL NOTICE.

Report on the Agriculture and Geology of Mississippi. By B. L. C. Wailes. Philadelphia: Lippincott, Grambo & Co. 1854.

This is a very excellent and interesting work, embracing a sketch of the civil and political, as well as of the natural history of the State of Mississippi, put into an octavo form, instead of the more pretentious and clumsy quarto, which have been adopted in some other States, and handsomely illustrated by chromo-lithographic plates, which are very good specimens of this beautiful art. The various drawings of the cotton plant in its youth, maturity, and decay, may be cited as especially creditable to the artist.

In this volume, the State of Mississippi has shown that it has the desire to distinguish itself among its fellows, in liberality and encouragement of science and arts within its boundaries; and we hope that its example will stimulate others of its colleagues, which ought to have been before it, in their contributions to the natural history of our country.

By the way, does any reader of our *Journal* know what prospect there may be of the State Geologist of Pennsylvania at last publishing that Report, for which our Legislature has so often and so liberally paid?

Ed.

JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

PROMOTION OF THE MECHANIC ARTS.

APRIL, 1855.

CIVIL ENGINEERING.

For the Journal of the Franklin Institute.

Description of McLaughlin's Patent Self-acting Railway Car Brake.

By H. Howson, C. E.

Railroad machinery has presented few such fertile subjects for the speculative schemes of theorists, as well as for the practical experiments of engineers, as that of car brakes. In support of this assertion, we have only to peruse a list of patents, dating from the time when railroad traveling had become somewhat general. That so much inventive talent should have been expended on this subject, will cease to be a matter of astonishment, when we reflect on its vast importance. The increased speed of railway trains and the necessity of repeatedly stopping the same, above all, the numerous and fearful accidents, which have, in too many cases, occurred through the inefficient machinery for retarding their progress, have all combined to render this a favorite subject for the consideration of the ingenious. That the means of stopping and retarding railway trains should be under the control of a single individual, is acceded to by all who are versed in railroad tactics. To effect this object, it becomes necessary that the braking apparatus of all the cars should be in some way connected together and rendered continuous throughout the whole train. In many instances, the tendency of the cars to be pressed against each other by their momentum in a partially retarded train, has been tried as a means of applying the rubbers to the wheels. The devices for this purpose have been both numerous and ingenious, but all, more or less complicated and deficient in the all important feature of durability, re-

sulting in that want of success, to which the present almost universal use of the ordinary hand brake bears ample testimony.

A self-acting car brake, continuous throughout the whole train and at the same time under the individual control of the engineer, has been invented and put into practice by Mr. T. G. McLaughlin of this city, and has been secured by letters patent both in this country and in England.

Simple and inexpensive in its construction, as well as efficacious in its results, this apparatus may, as one which has stood the severe test of time, as well as the scrutiny of experienced engineers, be declared the most successful automatic car brake hitherto introduced, and as such, is well worthy of the attention of railway companies and the traveling public.

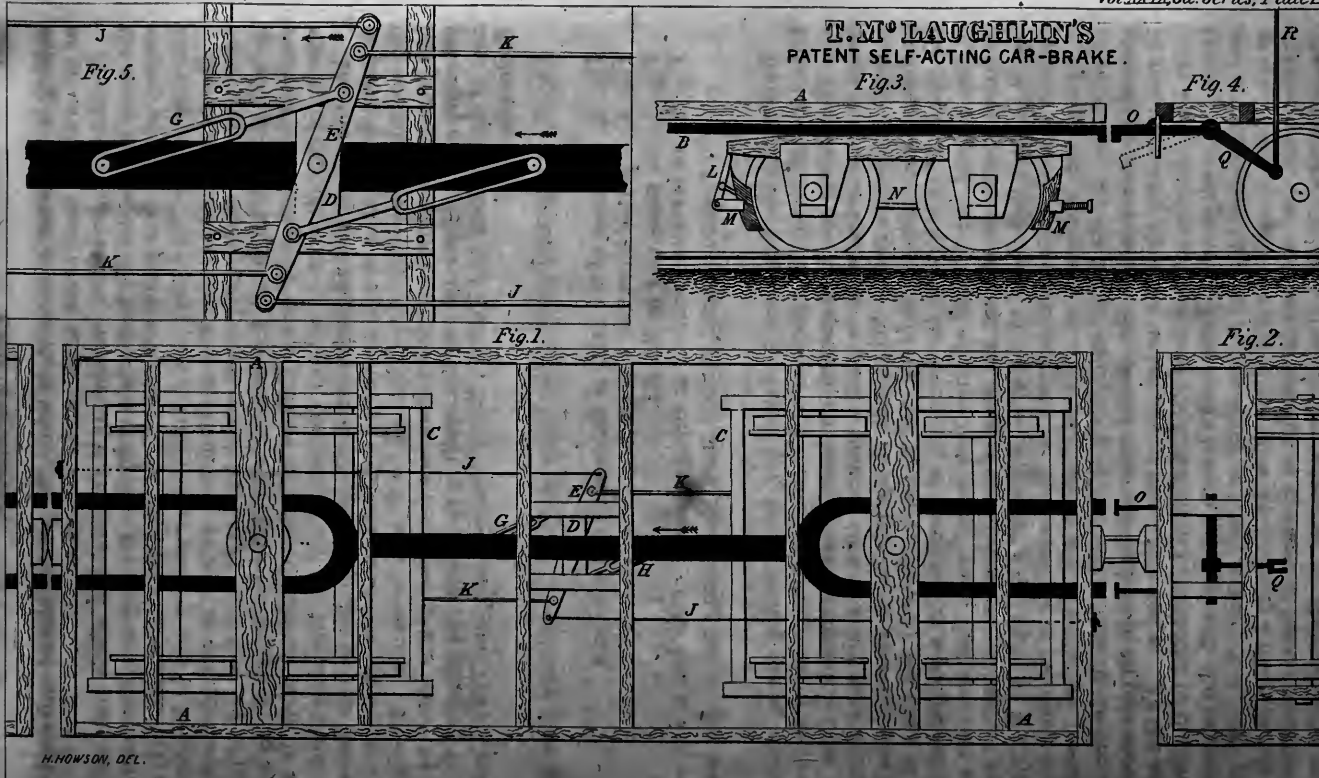
The invention was alluded to in the January number of this *Journal*, in partially mistaken terms, however, which the following description of the accompanying engraving (Plate II,) will tend to rectify. The latter has been prepared from working drawings furnished to the writer by the patentee, and is illustrative of his braking apparatus, as attached to the cars of the Camden and Amboy, North Pennsylvania, and West Chester Railroads.

Fig. 1, is a ground plan of the frame-work of an ordinary passenger car.
Fig. 2, the same of the back of the tender or brake van.
Fig. 3, a partial elevation of Fig. 1.
Fig. 4, the same of Fig. 2; and
Fig. 5, an inverted plan, to an enlarged scale, of the levers and rods for communicating motion from the sliding bar to the brake levers.

Underneath the frame-work of each car, is the sliding rod B, which is forked at each end for the purpose of clearing the king joints of the truck C. The sliding rod is supported on small rollers, suspended from the frame at suitable intervals in such a manner that it shall have a longitudinal movement only. When not in operation, (as shown in the engraving,) the forked ends of the rod B, project beyond the ends of the car frame, but not beyond the bumpers, as described in a recent number of this *Journal*, the amount of projection being such, that the cars may be brought together without the ends of the sliding rod of one car coming in contact with those of the next, when not acted upon by the apparatus on the tender hereafter referred to. To the middle of the frame-work is secured the bracket D, on a pin attached to which works the horizontal lever E. To the latter, and at equal distances from its centre, are jointed the rods G and H, the slotted ends of which slide on pins secured to and projecting from the under side of the sliding rod B. To the same lever E are likewise jointed the rods K, which are connected to the brake levers L of each truck. These brake levers, together with the rubbers M and spring connecting rod N, are of the ordinary construction, and such as are generally used in conjunction with the ordinary hand apparatus.

On a small shaft working in bearings at the back of the tender or brake van, are secured the two arms O, corresponding in their distance apart with the forked ends of the sliding bar. These arms are allowed to have a radial movement, as shown in dotted lines (fig. 4,) that movement being given by the lever Q on the same shaft as the arms O and the ver-

T. McLAUGHLIN'S PATENT SELF-ACTING CAR-BRAKE.



tical rod R, which is under the control of the attending engineer and brakesman.

Now supposing that the cars are in motion and that it be required to stop the same, the rod R is depressed by the attendant, and consequently the arms O raised to a horizontal position, so that their ends may coincide with the forked ends of the sliding rod B. The steam being now shut off from the engine, and the latter thereby partially retarded, the car will be urged with considerable force towards the tender, thereby bringing the sliding rod in contact with the ends of the arms O, and giving the former a movement in the direction of the arrows to a distance corresponding to the amount of projection of the arms O beyond the bumper of the tender. The rod G, which has the end of its slot in contact with the pin on the sliding rod, will have a simultaneous movement, thereby turning the horizontal lever E in the direction of the arrow, and through the rods K and levers L applying the rubbers to the wheels of both trucks.

Each car being furnished with apparatus similar to that above described, the movement is communicated throughout the whole train, and the brakes of every car put into efficient operation by the simple act of raising the arms O. Should the sliding bar be forced in a direction contrary to that pointed out by the arrow, the slotted rod H, would be the means of communicating motion from the sliding bar to the lever E, when a similar application of the rubbers to the wheels would take place, so that whichever end of the cars should chance to be nearest the tender, the same result will take place, without the necessity of making any alteration in the machinery.

To the extreme ends of the lever E are attached the rods J, which communicate with the ordinary windlass situated at each end of the car, so that the brakes can be applied by hand at pleasure without disturbing the sliding bar or rods G and H. The expense of furnishing a car with the above described apparatus, and applying it to the ordinary brakes, does not exceed thirty-five dollars, and the success which has hitherto attended its introduction on the above mentioned roads, has induced other companies to treat with the inventor concerning its adoption on their own line.

For the Journal of the Franklin Institute.

Disquisition on the Laws regulating the Slips of Screw Propellers in function of Form and Dimensions; based on a Digest of the Experiments made in 1845 *by M. Bourgeois, Engineer de Vaisseau, at the French Government Manufactory at Indret.* By B. F. Isherwood, Chf. Eng. U. S. N.

(Continued from page 163.)

Of the Influence exerted on the Slip of a Polybladed Screw, by fractioning the Pitch by the successive omission of Blade after Blade.

To determine the influence exerted on the slip of a screw composed of a certain number of blades, by successively omitting blade after blade, and disposing the remaining ones at equal distances around the axis, two complete sets of experiments were made on two different screws. One

screw, which I shall call A, was divided into five blades, and had a pitch of 19·69 inches. The other screw, which I shall call E, was divided into seven blades, and had a pitch of 27·56 inches. The other dimensions of both screws were the same; they had straight generatrices and directrices, were full threaded, and composed of one convolution of the thread. As the object of these experiments was to determine only the effect on the slip by the successive omission of blade after blade, the positive dimensions of the screw are immaterial, and in order to have the results strictly comparable, they are only given from the *same face of the same blades*. The material of these screws was wrought copper beaten *very thin*.

Screw A had the following dimensions, viz:

Diameter, . . .	15·75 inches.
Diameter of hub, ...	2·95 "
Pitch, ...	19·69 "
Length in direction of axis, . .	3·94 "

I have taken the experimental slips given by this screw with the different number of blades, and laid them off by scale as ordinates to a curve, whose corresponding abscissæ are represented by the number of the blades; a fair curve being then passed so as to join the greatest number of points, or to pass as much above one point as below another, will, I conceive, give results that can vary from the truth but in a trifling degree. The following table contains these and the experimental slips corresponding to the successive number of blades employed:

Number of blades.	Fractions used of the pitch.	Number of double courses ran.	Projected area on a plane at right angles to axis, in square inches.	SLIP. Mean slip of the screw in per centums of its speed, by the experiments.	Minimum and maximum slip of the screw in per centums of its speed, by the experiments.	Slip of the screw in per centums of its speed, by the curve.	Ratio of the slips by the curves proportionably.
5	5-5 or 1·0	2	188	30·4	30·4 30·4	30·4	1·0000
4	4-5 or 0·8	6	150	31·7	30·3 33·9	31·5	1·0362
3	3-5 or 0·6	3	113	33·0	31·9 33·7	33·9	1·1151
2	2-5 or 0·4	2	75	38·7	38·3 39·2	38·2	1·2566
1	1-5 or 0·2	2	38	45·3	45·1 45·5	45·3	1·4901

Screw E had the following dimensions, viz:

Diameter, . . .	15·75 inches.
Diameter of hub, ...	2·95 "
Pitch, ...	27·56 "
Length in direction of axis, . .	3·94 "

With this screw, which was composed first of seven blades, similar experiments were made as with the screw A, by successively omitting a

blade, and placing the remaining ones at equal distances around the axis. In order to have the results strictly comparable, those from the same face of the same blades only have been taken and grouped in the following table, together with the slips as determined by the curve described in the same manner as with screw A:

Number of blades.	Fraction used of the pitch.	Number of double courses ran.	Projected area on a plane at right angles to axis, in square inches.	SLIP. Mean slip of the screw in per centums of its speed, by the experiments.	SLIP. Minimum and maximum slips of the screw in per centums of its speed, by the experiments.	SLIP. Slip of the screw in per centums of its speed, by the curve.	Ratio of the slips by the curve, proportionably.
7	7-7 or 1·000	3	188	35·9	35·1 / 37·4	36·2	1·0000
6	6-7 or 0·857	3	161	37·0	35·9 / 37·8	36·3	1·0028
5	5-7 or 0·714	2	134	37·1	36·9 / 37·3	36·8	1·0166
4	4-7 or 0·571	5	107	38·1	37·3 / 38·7	38·1	1·0525
3	3-7 or 0·429	3	81	41·8	41·7 / 42·1	40·8	1·1271
2	2-7 or 0·286	3	54	45·9	45·4 / 46·1	45·7	1·2624
1	1-7 or 0·143	3	27	53·0	52·5 / 54·0	53·0	1·4641

It will be observed, that the results by the curves in the two tables, though from screws of different pitch and number of blades, offer a very close agreement, the curves being, in fact, almost identical; which will appear by commencing in the last table with the slip as unity given by five blades, and comparing the ratio of increase of slip as the blades are successively omitted, with the same ratio in the first table, as follows, viz:

Ratio of the increase of the slips by first table.	Ratio of the increase of the slips by last table.
1·0000	1·0000
1·0362	1·0351
1·1151	1·1087
1·2566	1·2418
1 4901	1·4402

An experiment was tried on screw H, by reducing its number of blades from 7 to 5, and placing the five at equal distances around the axis. Also on screw T by reducing the number of its blades from 7 to 4, and placing the four at equal distances around the axis. Screw T was composed of zinc; screw H was composed of wrought copper beaten *very* thin, and

both were full threaded. The following are the dimensions of these screws, viz:

	H.	T.
Diameter,	13·62 inches.	15·75 inches.
Diameter of the hub,	2·95 "	2·95 "
Pitch,	24·25 "	35·43 "
Length on axis,	3·46 "	3·39 "
Generatrix,	straight.	Straight and tangent to an inner cylinder, the blades being inclined 100° and 80° to the plane of the axis.
Directrix,	straight.	Curved, the angle of the tangents with the chord being 8°.

The following table contains the results, viz.:

Designation of the screw.	Number of blades.	Fraction used of the pitch.	Number of double courses ran.	Projected area on a plane at right angles to axis, in square inches.	Mean slip of the screw in per centums of its speed, by experiment.	Maximum and minimum slips of the screw in per centums of its speed, by experiment.
H	7	7-7 or 1·000	2	139	35·7	35·4 35·9
	5	5-7 or 0·714	1	99	36·6	
T	7	2-3 or 0·667	5	125	31·4	27·9 33·0
	4	0·381	7	72	32·7	29·5 34·3

Experiments were made with other screws, alike in all respects, except that the number of the blades was 14 and 7; also, with still other screws alike in all respects, except number of blades, which was 20 and 10. In these experiments one convolution of the thread was always used, and the screws of half the number of blades had a double length in the direction of the axis, presenting, of course, the same area of projected surface; the object being to ascertain if the slip was affected by the arrangement of the *same* surface into a more or less number of blades; but the results, which were in some cases almost identical, and in other cases widely varying, determining nothing in function of such an arrangement of the surface.

In experimenting on screws A and E by the successive omission of blade after blade, it was found, that the trepidations of the screw, or knockings at the stern of the boat, were *very great* when a *single* blade was used. When *two* blades directly opposed were used, the trepidations became *light.* When *three* blades placed equally around the axis were used, the trepidations became *nearly insensible;* and with *four* blades, entirely *ceased.*

Of the influence exerted on the Slip of a Polybladed Screw by Fractioning the Pitch by the successive diminution of the Length of the Screw by the passage of a Plane across it at right angles to Axis.

A complete set of experiments was made to determine the increase of the slip of the screw, by successively removing portions of its length by passing a plane across it at right angles to the axis. The screw F, on which these experiments were made, was full threaded, and at first composed of one convolution of the thread; the generatrix and directrix were straight, and the material was wrought copper beaten very thin. The screw was of the following dimensions, viz:

Diameter, ...	15·75	inches.
Diameter of the hub, . . .	3·94	"
Pitch, ...	31·50	"
Length on axis, . . .	3·94	"

With this screw the experiments were made in the following manner, viz: It was first experimented with using the whole convolution of the thread and a length of 3·94 inches; this length was then successively diminished by one-seventh, the number of blades, of course, remaining constant. The following table contains the result of each diminution of length, to which I have added a column of results derived from a curve formed by laying off with a scale the slips for ordinates and the corresponding lengths of screw for abscissæ, and passing a fair curve through them: these results from the curve I believe to be very nearly correct.

Number of blades.	Fraction used of the pitch.	Length of the screw, in inches.	Number of double courses ran.	Projected area of the screw on a plane at right angles to axis, in square inches.	SLIPS. Mean slip of the screw in per centums of its speed, by experiment.	Minimum and maximum slips of the screw in per centums of its speed, by experiment.	Slip of the screw in per centums of its speed, by the curve.	Ratio of the slips by the curve.
8	7-7 or 1·000	3·94	3	183	34·5	33·5, 35·4	35·0	1·0000
"	6-7 or 0·857	3·38	"	157	35·7	34·6, 37·1	35·7	1·0200
"	5-7 or 0·714	2·81	"	130	38·0	37·5, 38·8	37·0	1·0571
"	4-7 or 0·571	2·25	"	104	38·9	38·6, 39·6	38·6	1·1029
"	3-7 or 0·429	1·69	"	78	38·7	38·3, 39·4	41·0	1·1714
"	2-7 or 0·286	1·13	"	52	45·2	44·8, 45·5	44·2	1·2629
"	1-7 or 0·143	0·56	"	26	49·2	48·2, 50·0	50·0	1·4286

The experiments we have cited on screws E and F, which screws are sufficiently near alike for this purpose, enable us to determine the relative effect produced on the slip by equal diminutions of surface, whether made by the omission of blades or by the diminution of the length of the

screw. The surface in both screws was first one convolution of the thread, and then diminished successively by one-seventh at a time; the diameters and original lengths of the screws were the same, the number of blades (7 and 8) were nearly the same, the pitches were as 1·000 and 1·143, and the slips varied but little. It is clear, then, that the results are fairly comparable. They are as follows, viz:

E. (Surface reduced successively one-seventh by the omission of blade after blade.) Ratio of the increase of the slips.	F. (Surface reduced successively one-seventh by the repeated diminutions of the length of the screw.) Ratio of the increase of the slips.
1·0000	1·0000
1·0028	1·0020
1·0166	1·0571
1·0525	1·1029
1·1271	1·1714
1·2624	1·2629
1·4641	1·4286

It will be perceived from the above figures, that the influence exerted on the slip of the screw by diminutions of its surface, is sensibly the same, whether equal amounts of diminution be made by omitting blades, retaining the same length of screw, or by reducing the length of the screw, retaining the same number of blades; and this result has been confirmed by other experiments. The following, which is the mean of the above ratio, may be taken, generally, as the—

Ratio of the increase of the Slip from fractioning the Pitch successively one-seventh, that is to say, by successive reductions of one-seventh of the Surface.

Fractions used of the pitch.	Ratio of the increase of the slip.
7-7 or 1·000	1·0000
6-7 or 0·857	1·0024
5-7 or 0·714	1·0369
4-7 or 0·571	1·0777
3-7 or 0·429	1·1492
2-7 or 0·286	1·2626
1-7 or 0·143	1·4463

If, in the above table, we compare the increase of slip resulting from halving the surface, we shall find the ratio of that increase to be about the same, let the absolute amounts of surface taken be what they may: for instance, let us compare the ratio of the slips obtained from using the fractions one-seventh and two-sevenths of the pitch,—from using two-sevenths and four-sevenths of the pitch,—and from using three-sevenths and six-sevenths of the pitch, and we shall obtain the following results, viz:

Fractions used of the pitch, representing relatively surfaces of 1 and 2.	Ratio of the slips, taking the slip with the half surface as unity.
1-7 and 2-7	1·146
2-7 and 4-7	1·162
3-7 and 6-7	1·146
Mean,	1·151

From the above we find, that within the limits of one convolution of the thread and with the same screw, halving the surface either by reducing the length one-half, preserving the same number of blades, or by omitting one-half the number of blades, preserving the same length, increases the slip in the ratio of 1·151 to 1·000, or two-thirteenths; and this ratio is constant for all surfaces whose areas compare as 1 and 2, be the absolute extent of those surfaces what they may. For example, if using six-sevenths of one convolution of the thread give a slip of 30 per centum, then using three-sevenths of the same convolution will give a slip of ($1·151 \times 30 =$) $34\frac{1}{2}$ per centum; if using two-sevenths of one convolution give a slip of 39 per centum, then using one-seventh of the same convolution will give a slip of ($1·151 \times 39 =$) 45 per centum, and so on.

An experiment was tried with screw c, to determine the increase of slip resulting from a diminution of the length of the screw one-half by a plane passing at right angles to axis; other things remaining the same. This screw was full threaded and was originally composed of convolution of the thread; the generatrix and directrix were straight, and the material was wrought copper beaten very thin. The dimensions of the screw were as follows, viz:

Diameter, ...	15·75 inches.
Diameter of hub, ...	3·94 "
Pitch, ...	23·62 "
Length in direction of axis, . .	3·94 "

The results will be found in the following table, the same face being used to propel with:

Number of blades.	Fraction used of the pitch.	Length of the screw, in inches.	Number of double courses ran.	Projected area of the screw on a plane at right angles to axis, in square inches.	SLIPS. Mean slip of the screw in per centums of its speed, by experiment.	SLIPS. Minimum and maximum slips of the screw in per centums of its speed, by experiment.
6	6-6 or 1·00	3·94	3	188	28·5	28·1 32·0
"	3-6 or 0·50	1·97	"	94	34·5	33·4 35·7

Of the Influence exerted on the Slip of the Screw by placing the blades checkerwise.

An experiment was made to determine, whether any influence would be exerted on the slip by taking half the number of blades comprising the screw, and disposing them immediately behind the remaining half checkerwise, or in such a manner that the rear blades equally divided the spaces between the front blades. This arrangement, of course, just doubled the length of the screw, and, also, doubled the width of the

spaces between the blades. The screw experimented with had the following dimensions, and the same face of the blades was used throughout.

Diameter,	15·75 inches.
Diameter of hub,	3·94 "
Pitch,	23·62 "
Length in direction of axis,	1·97 "
Number of blades,	6.
Fraction used of the pitch,	0·50.
Projected area of the screw on a plane at right angles to axis,	94 square inches.
Generatrix and directrix,	straight.

With the above screw three double courses were ran, giving slips of 33·4, 34·3, and 35·7 per centums: *mean slip* 34·5 *per centum.*

Three of the original six blades were then taken out, and placed as before described, checkerwise, immediately behind the remaining three, making the length of the screw in direction of the axis 3·94 inches. Three double courses were again ran, giving slips of 34·0, 34·9, and 35·8 per centums: *mean slip* 34·9 *per centum*, or the same as before.

No influence was, therefore, exerted on the slip of the screw by the checkerwise arrangement of its blades.

It will be observed, that these experiments amount to precisely using the same surface, but in one case dividing it into 6 blades, and in the other case dividing it into only 3 blades, but each blade of double length; and the result exactly corresponds to the conclusion previously arrived at, from a comparison of the effect produced on the slip by decreasing the number of blades, preserving the same length of screw, or by decreasing the length of the screw, preserving the same number of blades; the surface of the screw being always kept constant, viz: that the slip of equal amounts of the same screw surface continues the same, whether that surface be divided into few or many blades.

General Tables 1st and 2d, containing Comparable Experiments on Various Screws.

The data given in the following tables, 1st and 2d, are believed to be accurate and fairly comparable throughout; it has been selected from a large mass after a careful revision. With some of these screws other experiments were made to determine single points, and although the slips were then sometimes not quite consistent with what are here given, and not absolutely true, yet they were, doubtless, comparatively correct for the circumstances under which they were made, which circumstances being the same and at the same time, the *comparative* results can be confidently accepted. The slips from the screws of the fourth series, table 2d, are a very little too small *comparatively* with the screws of the other series of tables 1st and 2d, owing to the greater stiffness of their blades, resulting from their smaller diameter.

TABLE I.—*Containing the Data and Results of Experiments on Full-threaded Screw composed of one Convolution of the Thread, with straight Generatrices and Directrices.*

Series.	Designation of the screw.	DIAMETERS. Diameter of the screw in inches.	DIAMETERS. Diameter of the hub in inches.	Pitch of the screw in inches.	Ratio of the pitch to the diameter of the screw, the diameter being unity.	Number of blades of the screw.	Length of the screw in the direction of the axis, in inches.	Area of the screw projected on a plane at right angles to axis, in square inches.	Number of double courses ran.	SLIPS. Mean slip of the screw in per centums of its speed.	SLIPS. Minimum and maximum slips of the screw in per centums of its speed.
1st	A	15·75	3·94	19·69	1·25	5	3·94	183	3	23·7	22·8 / 24·7
	B	"	2·95	"	"	"	"	188	2	24·6	23·6 / 25·6
	C	"	3·94	23·62	1·50	6	3·94	183	3	28·5	28·1 / 29·2
	D	"	"	27·56	1·75	7	"	"	5	32·6	32·0 / 33·1
	E	"	2·95	"	"	"	"	188	14	32·7	25·4 / 37·4
	F	"	3·94	31·50	2·00	8	"	183	3	35·6	34·7 / 36·7
	G	"	"	35·43	2·25	9	"	"	3	41·7	41·3 / 42·9
5th	H	13·62	2·95	24·25	1·78	7	3·46	139	2	35·7	35·4 / 35·9

TABLE II.—*Containing the Data and Results of Experiments on Part-threaded Screw composed of one Convolution of the Thread, with Straight Generatrices and Directrices.*

Series.	Designation of the screw.	DIAMETERS. Diameter of the screw in inches.	DIAMETERS. Diameter of the interior of the blade, in inches.	Pitch of the screw, in inches.	Ratio of the pitch to the diameter of the screw, the diameter being unity.	Number of blades of the screw.	Length of the screw in the direction of the axis, in inches.	Area of the screw projected on a plane at right angles to axis, in square inches.	Number of double courses ran.	SLIPS. Mean slip of the screw in per centums of its speed.	SLIPS. Minimum and maximum slips of the screw, in per centums of its speed.
2d	I	15·75	7·875	15·98	1·015	14	1·14	146	2	20·9	20·7 / 21·0
	J	"	"	22·84	1·450	10	2·28	"	2	31·3	31·0 / 31·6
	K	"	"	27·56	1·750	14	1·97	"	2	37·8	37·7 / 37·9
	L	"	"	39·37	2·500	10	3·94	"	2	52·6	52·3 / 52·9
3d	M	15·75	11·81	39.37	2·500	10	3·94	85	3	63·4	61·8 / 65·2
4th	N	12 28	5·91	30·71	2·500	10	3·07	91	2	60·3	59·9 / 60·7
	O	"	"	21·50	1·750	14	1·54	"	2	43·6	43·1 / 44·1

Of the influence exerted on the Slip of the Screw by the length of its Pitch.

In order to determine the influence exerted on the slip of the screw by the length of its pitch, the data in tables 1 and 2, can be employed; the screws of the first, second, and fourth series being comparable with those of their own series;—and for this purpose the "ratios of the pitches" will be compared with the "ratios of the slips," as in the following table, viz:

Series.	Designation of the screw.	Pitch of the screw, in inches.	Slip of the screw in per centums of its speed.	RATIOS. Ratio of the pitches.	Ratio of the slips.	Series.	Designation of the screw.	Pitch of the screw, in inches.	Slip of the screw in per centums of its speed.	RATIOS. Ratio of the pitches.	Ratio of the slips.
1st	A	19·69	23·7	1·000	1·000	2d	I	15·98	20·9	0·700	0·668
	B	19·69	24·6	1·000	1·038		J	22·84	31·3	1·000	1·000
	C	23·63	28·5	1·200	1·203		K	27·56	37·8	1·207	1·208
	D	25·56	32·6	1·400	1·376		L	39·37	52·6	1·724	1·680
	E	27·56	32·7	1·400	1·380						
	F	31·50	35·6	1·600	1·502	4th	N	30·71	60·3	1·429	1·383
	G	35·43	41·7	1·800	1·760		O	21·50	43·6	1·000	1·000

If in the above table, we compare the columns of the "ratios of the pitches" and of the ratios of the corresponding slips, we shall find them to offer so very close an agreement, that we are warranted in considering it experimentally established, that the slips of screws, similar in other respects, are in the direct ratios of their pitches; that is to say, doubling the pitch doubles the slip.

Of the influence exerted on the Slip of the Screw by cutting out the inner portion of the Blades.

The influence exerted on the slip of the screw by cutting out the inner portion of its blades, by the passage through it of a cylinder with an axis coincident with the axis of the screw, can be determined by a comparison of the slips of the screws of series first in table 1, with those of the screws of series 2d and 3d in table II.

In the first place, the determination will be made for a cutting out of the inner part of the blades, by the passage of a cylinder whose diameter equals half the diameter of the screw; and for this purpose the screws of series 1st are compared with those of series 2d, but, in order to make this comparison, inasmuch as the screws of series 1st and 2d have different pitches, it is necessary to ascertain what would be the slips of the screws of series 2d if they had the pitches of the screws of series 1st; then, by taking the mean of all the slips of the screws of series 1st, and comparing it with the mean of the mean determination of the slip of each screw of series 2d, on the supposition that it had the pitch of the screw of series 1st, with which it was compared, we shall obtain, as determined by the mean of all the experiments, the increase of the slip of the screw due to this particular cutting out of the inner part of its thread.

The calculation of the slips that the screws of series 2d would have with the pitches of these screws of series 1st with which they are compared, has been made from these experimental slips, diminished or increased in the direct ratio that their actual pitches were less or more than the pitches of said screws of series 1st. The following table contains the results of the comparison between the screws of series 1st and 2d, viz:

SERIES 1ST.	SERIES 2D. Screws.	SERIES 2D. Slips which screws of series 2d would have with the pitches of screws of series 1st.	SERIES 1ST.	SERIES 2D. Screws.	SERIES 2D. Slips which the Screws of series 2d would have with the pitches of screws of series 1st.
Screw A. Slip 23·7	I	25·7	Screw F. Slip 35·6	I	41·2
	J	27·0		J	43·2
	K	27·0		K	43·2
	L	26·3		L	42·1
Mean,		26·5	*Mean,*		42·4
Screw C. Slip 28·5	I	30·9	Screw G. Slip 41·7	I	46·3
	J	32·4		J	48·5
	K	32·4		K	48·5
	L	31·6		L	47·3
Mean,		31·8	*Mean,*		47·6
Screw D. Slip 32·6	I	36·1			
	J	37·8			
	K	37·8			
	L	36·8			
Mean,		37·1			

The mean of the mean slips of the screws of series 2d in the above table is $\left(\frac{26·5+31·8+37·1+42·4+47·6}{5}=\right)$ 37·1 per centum: the mean of the slips of the screws of series 1st in the above table is— $\left(\frac{23·7+28·5+32·6+35·6+41·7}{5}=\right)$32·4 per centum, difference, 4·7 per centum absolutely, or $\left(\frac{37·1—32·4\times100}{32.4}=\right)$ $14\frac{1}{2}$ per centum relatively of the slips of series 1st. Hence we find, that cutting out the inner part of the blades by the passage of a cylinder whose diameter equals half the diameter of the screw, increases the slip one-seventh; that is to say, if the slip of the full threaded screw were 28 per centum, the slip of the same screw when cut out as above, would be 32 per centum.

In the second place, the determination will be made for the cutting out of the inner part of the blades by the passage of a cylinder whose diameter is three-fourths the diameter of the screw; and for this purpose the screws of series 1st will be compared consecutively with screw M of series 3d. This comparison, made as in the first case, gives the results contained in the following table, viz:

SERIES 1ST.		SERIES 3D.	
Screws.	Experimental slips.	Screws.	Slips which screws of the 3d series would have with the pitches of the screws of the 1st series.
A	23·7	M	31·7
C	28·5	"	38·0
D	32·6	"	44·4
F	35·6	"	50·7
G	41·7	"	63·4
Mean,	32·4	*Mean,*	45·6

The mean of the slips of the screws of series 1st in the above table is 32·4 per centum; the mean of the slips of the screw M of series 3d is 45·6 per centum; difference 13·2 per centum absolutely, or—

$\left(\frac{45·6—32·4 \times 100}{32·4} = \right)$ 40·8 per centum relatively of the slip of series 1st.

Hence, we find, that cutting out the inner part of the blades by the passage of a cylinder whose diameter equals three-fourths of the screw, increases the slip two-fifths; that is to say, if the slip of the full threaded screw were 28 per centum, the slip of the same screw, when cut out as above, would be 39 per centum.

Again, the determination of the effect exerted on the slip of the screw by cutting out the inner part of its blades by a cylinder whose diameter equals 0·481 of the diameter of the screw, can be made by comparing the results of screw H, series 5th, table I, with the results of the screws of series 4th, table II; the slips will be made comparable by modifying those of series 4th in the direct ratio of the pitch and in the ratio of the square of the diameter of screw H as hereinafter shown, which screw is selected for comparison because its diameter and pitch are but little different from those of the screws of the 4th series. The results will be found in the following table, viz:

SERIES 5TH.		SERIES 4TH.	
Screw.	Experimental slip.	Screws.	Slips which screws of the 4th series would have with the diameter and pitch of the screw of the 5th series.
H	35·7	N	38·9
"	"	O	40·1
		Mean,	39·5

The mean of the slips of the screws of 4th series is 39·5 per centum in the above table, the slip of screw H is 35·7 per centum; difference, 3·8 per centum absolutely, or $\left(\frac{39{\cdot}5-35{\cdot}7\times100}{35{\cdot}7}=\right)$ 10·7 per centum relatively of the slip of screw H. Hence we find, that cutting out the inner part of the blades by the passage of a cylinder whose diameter equals 0·481 of the screw, or twelve-twenty-fifths, increases the slip two-nineteenths; that is to say, if the slip of the full threaded screw were 28 per centum, the slip of the same screw would be 31 per centum.

(To be Continued.)

Translated for the Journal of the Franklin Institute.

Composition of Betons not attacked by Sea Water. Researches of M. Vicat and Son.

The difficulty of compounding in the moist way, double silicates of alumina and lime, capable of absolutely resisting sea-water, induced my son and myself to endeavor to form double silicates of magnesia and alumina in the same way. We have succeeded beyond our hopes in very numerous cases, and under certain conditions easily realizable as to the chemical composition of the pozzolanes to be employed, and with proportions of magnesia far less than those of the lime used in such cases.

If it were then possible to obtain magnesia at a price available in public works, the problem of the formation of inattackable betons would be resolved. According to the opinion of M. Balard, one of our learned chemists, and a member of the Academy, the mother-waters of salt marshes, of which no use is made, might furnish this base at the desired price.

We hope that the publicity given to this note may induce the companies who own our salt-works to try this extraction of magnesia. The chemical processes which will have to be applied on a large scale, we theoretically know.—*Acad. Sciences, Paris, November,* 1854.

Extract from the Seventh Annual Report of the Ohio and Pennsylvania Railroad Company, Pittsburgh, January 25, 1855.

"A drought of uncommon intensity and duration diminished very much the crops along the line, and the delay in the opening of the Ohio and Indiana Railroad to Fort Wayne, which did not take place until the first of November, deprived the road of a portion of its anticipated business.

"Notwithstanding these circumstances, the earnings of the road in the year 1854, after deducting the sums received for other companies, have been $1,111,626·18. The earnings in 1853 were $668,004·49, and the increase has been $443,621·69, *or more than* 66 *per cent.* This is a striking fact, of the most encouraging character, in estimating the value of the line.

"The transportation expenses and repairs have amounted to $499,508·87, being about forty-five per cent. of the gross earnings, and the net

earnings have been $612,117·31—being about eleven per cent. on the cost of the road, with its present equipments—whilst more than half of this cost is represented by bonds, bearing seven per cent. interest and having a long time to run.

"The Board think that the Stockholders have great reason to be satisfied with the regularity, safety, and success with which the road has been worked, and with the amount of its earnings during the past year."

For the Journal of the Franklin Institute.

Railroad Crossing of the Hudson River at Albany. By EDWARD W. SERRELL, Civ. Eng.

For many years past the difficulties that have been experienced at this point, to the great lines of travel that centre here, have called loudly for some more adequate and suitable method of crossing than has existed.

If perpetual summer reigned, the annoyances would be but trifling, comparatively; but the changes of the seasons bring so many conditions that are burthensome, that it has long been considered as of the utmost importance to the traveling and commercial public, that some method should be adopted and brought into use, by which this break of the lines should be avoided.

Various plans have been suggested, and from time to time the legislature has been petitioned for a charter authorizing the construction of bridges of different descriptions.

The New York Central Railroad, and the Boston and Albany Railroads descend into the Valley of the Hudson at this point more or less abruptly, and the Hudson River Railroad lies near the level of the stream.

The banks on either side are moderately steep, but if the interests of the communities above Albany on the river, would agree to it, the physical obstacles in the way of bridging could readily be overcome, and at such cost as would be very remunerative.

Even in the summer time very great delay is experienced at the ferry, both to passengers and the mails—freight is diverted, and ascends the stream, crossing the river at Troy, and descends on the easterly side towards Boston or New York—but in the Spring of the year, during floods, and before the ice has formed sufficiently at the commencement of winter, and very frequently during the periods of thaws, the river opposite Albany is for days, and sometimes weeks together, quite impassable.

But the question arises, what plan can be adopted that shall supply the requisite facilities without interfering with the navigation, and shall not encroach upon the vested rights of the people living upon the upper waters of the stream ?

Drawbridges of several kinds have been planned, but none, so far, seem unobjectionable, at least the legislature has not authorized any of them to be built as proposed. Either the height above the water, the insufficiency of the passage way, the obstruction to the stream, the sedimentary deposits which it has been supposed would be formed, or the ice jams that were feared, or the effects of wind currents produced, or some other real

or imaginary difficulties have thus far, together with local prejudices and personal interests, which no doubt have had their weight, prevented the execution of any plan whatever.

It has been proposed to *tunnel* under the bed of the river, and such a project may be feasible, but this plan is, also, surrounded with difficulties. The contiguity of the steep slopes of the valley to the river, makes it more than questionable, whether such *lines* can be obtained that in other respects would be desirable or even admissible, upon which suitable *gradients* can be had for entering and leaving such a work.

The great cost of tunneling in the material here met with, and under the existing physical circumstances, cannot be doubted; but even this might be no more than the business to be done would warrant, if other things were favorable.

Cannot some one suggest a plan that shall meet all the requirements and be free from all objections? Is there not engineering talent enough in the country to devise means that shall give to the railroads a suitable crossing without interfering with the navigation of the river? Cannot a plan be presented in such a plain and positive manner that all will agree to it? Surely it can be.

It must be conceded on all sides that this is by far the most important place upon any line in America, that admits of an unbroken connexion; local prejudices would doubtless give way before an adequate device. Some plan must, sooner or later, be adopted; this is a good field for enterprising talent.

Passage of the first Locomotive over the Suspension Bridge over the Falls of Niagara.

To the Committee on Publications.

The First Locomotive passed over the Niagara Suspension Bridge yesterday, at a moderate speed. This engine, weighing 23 tons, caused a slight depression of the superstructure, which, in the centre, measured 3½ inches, but produced no vibration whatever. The experiment was repeated to-day with two other engines, making separate trips at a speed of 8 miles per hour. One of these weighing 34 tons, and with a well filled passenger car attached, caused a depression in the centre of 5½ inches.

Considering the unfinished state of the work, the above results, and the total absence of vibration, are highly gratifying. The success of the work may be considered as established. The strongest gales have no effect on it. The Bridge will be open for the regular passage of trains in about eight days.

John A. Roebling.

March 9, 1855.

AMERICAN PATENTS.

List of American Patents which issued from January 30th, to February 27th, 1855, (inclusive,) with Exemplifications.

JANUARY 30.

185. For an *Improved Implement for Boring Wells;* I. J. W. Adams, Sharptown, Md.

Claim.—"The employment or use of the spring attached to the handle of the swinging or suspended auger, and arranged with a knob or projection on its outer surface, which knob or projection catches into a cavity in the under surface of the bail, for the purpose of holding the auger in its proper position while being operated."

186. For an *Improvement in Clarifying Glue;* Wm. Adamson, Philadelphia, Pa.

Claim.—"The employment of the ordinary calcined and ground plaster of paris, or that superfine quality of it, known in commerce under the name of 'terra alba,' for the purpose of clarifying glue, gelatin, size, &c."

187. For *Hot Air Furnaces;* Abel H. Bartlett, Kings' Bridge, New York.

Claim.—"In combination with the arrangement of the serpentine fire and air flues or courses, providing each horizontal flue with an escape casing or jacket, connected by branch or otherwise, (each horizontal casing,) with a gas pipe or pipes uniting them with the chimney. The arrangement of the fire flues and air heating passages, traversing at right angles to each other, when combined with division plates, or their equivalents, so arranged that the one stratum or current of air to be heated passes upwards throughout the several hot air passages or channels in a serpentine course, similar to but at right angles with the course given the flame, simultaneously passing upwards in the fire flues, over, under, and between the hot air passages or flues."

188. For a *Car Ventilator;* B. T. Babbitt, City of New York.

Claim.—"The arrangement of a wind wheel, in connexion with a wire gauze disk or screen, revolving in a tank of water, the air passing through the said disk previous to entering the car."

189. For an *Improvement in Seed Planters;* John Blackwood, Franklin County, O.

Claim.—"The additional hopper to catch the seed which falls off of the slide after it passes the brush."

190. For an *Improvement in Seed Planters;* Job Brown, Lawn Ridge, Illinois.

Claim.—"The combination of the cups, placed obliquely on a rotating cylinder, with the distributing plates."

191. For a *Fountain Brush;* Dexter H. Chamberlain and J. Hartshorn, Boston, Mass.

Claim.—"Arranging or applying the brush, the valve, its rod and the socket tube together, so that not only shall the brush be fixed directly to the valve, and be movable backward and forward, and around with and by it, but the socket be made to so encompass the valve and brush that the marking fluid may flow down around the external surface of the brush before penetrating into its interior. So combining with the slide and the fountain, a mouth tube open at both ends, that such tube may not only serve to enable a person to supply the reservoir with paint or marking fluid, but also to enable him to move longitudinally, or rotate the rod and its valve and brush. The float, in combination with the opening at the inner end of the tube, and so arranged to move on the slide rod and within the tube, and to operate therewith."

192. For an *Improvement in Ploughs;* Alfred Doe, Concord, New Hampshire.

Claim.—"Two separate furrow-boards, arranged to vibrate perpendicularly, independent of the point and share, so as to turn alternately right and left furrows on level or inclined land with equal facility, operating in combination with a swivel point and shares, arranged to vibrate under the land side with the body or front portion of the furrow-boards. In combination with the swivel point, shares, body, and one of the furrow-boards mentioned in the above claim, a sub-furrow-board, arranged to vibrate perpendicularly, so constructed as to turn a sub-soil furrow in one direction upon the top of the furrow just ploughed in one direction, and a sub-soil in the other."

193. For an *Improvement in Dies for Cop Tube Machines;* James Eaton, Townsend Harbor, Massachusetts.

Claim.—"Consists in so securing the step to the die that it may at any time be dressed off and again brought up to place. The method described, of securing the step to the die."

194. For a *Double Acting Force Pump;* George Fowler, Northford, Connecticut.

Claim.—"The combination of the solid piston with the cylinder and reservoir, when the piston is inserted from the lower end of the cylinder, and worked by a parallel side rod or shaft outside of the cylinder, (whether for single or double acting pumps,) so as to constitute an efficient lifting pump, (without suction valves.")

195. For an *Improvement in the Yoke of Shirts;* Hezekiah Griswold, Hartford, Conn.

Claim.—"Consists in applying to the upper part of a shirt, a compound or graduated yoke, said compound yoke being composed of two parts or sections, and made with two or more points, which being inserted, thereby expand the form, graduating the shape of the yoke and shirt to correspond with the form of the body. The compound yoke."

196. For an *Improvement in Clover Hullers;* Jonathan Hibbs, Tullytown, Penna.

Claim.—"Combining with the concave shell two flanches diverging from a central point, and so acting as to divide the chaff from the fresh fed straw during the time that the former is passing a second time round the cylinder."

197. For an *Improvement in Piano Fortes;* Alexander Hall, Lloydsville, Ohio.

Claim.—"Sinking the middle octave bridge below the level of the normal strings, so as to be clear of their vibrations. In combination with the depressed bridge, the perforations in the bridge, on the level with the top of the bridge. The extra hitch-plate, in combination with the depressed bridge and perforated bridge. The adjustable bridge-pin for the normal strings, furnished with a screw and the notches and channels on its two sides, so that the normal strings can be regulated in their relative distances from the octave strings, either vertically or laterally, or both. Making the buff stop of two qualities of leather, a hard and a soft, for producing the harp effect."

198. For an *Improvement in Rain Staff Screws for Ship Carpenters;* John Hobbs, Hallowell, Maine.

Claim.—"The arrangement of the screw stems passing through the rain staff, the sharp threaded screws forced into the timber or side of the vessel by the lever inserted in the aperture and the nuts, moved by the lever to force the rain staff towards the vessel, together with the set-down on each screw, for the purpose of inserting wedges between it and the edge of the plank, to bring the plank into place for spiking on the side of the vessel."

199. For an *Improvement in Carriage Wheels;* Washburn Race and Birdsill Holly, Seneca Falls, New York.

Claim.—"The compressed tenon, in combination with the annular cavity."

200. For an *Improvement in Augers;* Russell Jennings, Deep River, Connecticut.

Claim.—"So constructing the cutting edges of a double twist auger bit that the vertical scores shall follow the chisel, *i. e.*, so that the cutting edges of scores and chisel shall never intersect the worm or helix of the shaft at the same point."

201. For an *Improvement in Locking Spindle Door Latches;* William H. McNamee, Philadelphia, Pennsylvania.

Claim.—"The guides and the rim of the escutcheon, the shelf on the face plate, and the upright stem inclosed with a spiral wire working through the shelf piece. Also, the projecting arm on the spindle, and the forked bolt."

202. For an *Improvement in Machinery for Felting Hat Bodies;* Sidney S. Middlebrook, James B. Blakeslee, and Charles F. Blakeslee, Newton, Connecticut.

Claim.—"The employment or use of the two bed plates, corrugated on their inner surfaces, the upper bed or plate having an up and down and also a lateral vibratory movement given it by the cams, or their equivalents, and the lower bed being elastic or yielding, for the purpose of subjecting the hat bodies to a rolling motion under a requisite pressure."

203. For an *Improvement in Sewing Machines;* John B. Nichols, Lynn, Mass.

Claim.—"The combination of a binding guide with a sewing machine, meaning to claim the combination of mechanism whereby the operations of directing or applying the binding to the edge of any material, and sewing it thereon, are conducted by an automatic process."

204. For an *Improvement in the Construction of the Frame of Grass Harvesters;* A. Palmer, Brockport, New York.

Claim.—"Connecting the wheel, the cutter beam, and the tongue to the frame, in such manner that the frame operates as a lever, of which the axle of the wheel is the fulcrum, and by which means the cutter beam rises and falls independent of the wheel, thereby adapting itself to undulating surfaces, and by which means the draft of the team holds the cutter beam snug to the ground, thereby causing the machine to cut close and smooth."

205. For an *Improvement in Lantern Frames;* Elijah F. Parker, Proctorville, Vt.

Claim.—"Passing the guard wires of lantern frames through suitable holes in the corners or uprights, by which means soldering at such points may be dispensed with."

206. For an *Improvement in Cable Stoppers;* Jesse Reed, Marshfield, Mass.

Claim.—"The arrangement of the lever. the crank, and the upper jaw, whereby the latter is allowed to accommodate itself to the varying size of the links, and the operation of stopping the chain is adjusted by the friction of the chain itself upon the upper jaw."

207. For an *Improved Force Pump;* Henry Rogers, Ferrisburgh, Vermont.

Claim.—"The combination of the suspended valve bucket with the stationary hollow plunger, or of the suspended hollow plunger with the stationary valve bucket, when so constructed, arranged, and operated as to serve automatically to clear the delivery pipe of water."

208. For an *Improvement in Harvester Cutters;* David Russell, Drewersbury, Ind.

Claim.—"The combination of cutters with an endless chain or chains."

209. For an *Improvement in Portable Fire Arms;* Alexander O. H. P. Sehorn, Murfreesboro', Tennessee.

Claim.—"The combination of the box, springs, and coiled spring, hammer and casing, when used in connexion with an external case."

210. For an *Improvement in Methods of Working Franklinite Ore;* Thaddeus Selleck, Greenwich, Connecticut.

Claim.—"The process of reducing Franklinite ore to obtain iron and the white oxide of zinc therefrom, by working it under a lighter head in a vertical walled low cupola furnace."

211. For an *Improvement in Carriage Wheels;* John Skelley, Brooklyn, New York.

Claim.—"Constructing the wheel as having a concentric ring or band constructed of wood, and secured by metallic bands on its sides, said ring or band being at any proper point between the hub and rim of the wheel, and having the half spokes secured between the rim and ring or band, and the whole spokes passing through said ring or band."

212. For an *Improvement in Straw Cutters;* G. L. Squier, Chicopee Falls, Mass.

Claim.—"The combination of the circular cutters or knives, and finger plates with the fingers attached to them, when said cutters and finger plates are secured the proper distance from each other on their shafts, by means of the rods and nuts."

213. For an *Improvement in Cultivator Teeth;* Joseph Stockdale, Ypsilanti, Michigan.

Claim.—"The reversible cast iron plate with the groove on the under side, round cast iron stay pin on upper side, and also the application of the top of the cultivator tooth in the groove aforesaid, and also the application of the wrought iron bolt or shank passing through the said plate."

214. For an *Improvement in the Construction of Furnaces for Zinc White;* Jonathan G. Trotter, Newark, New Jersey.

Claim.—"The use of the atmospheric air supply pipe, flues, heating chambers, and

series of apertures in the sides thereof, or substantially like parts, for the purpose of conveying into the oven a great number of infinitely small jets or blasts of heated atmospheric air, (independent of the blast of atmospheric air supplied through the ash pit of the furnace to support combustion,) for the purpose of more thoroughly consuming the gases from the ore and carbon."

215. For an *Improvement in Processes for Making India Rubber Cloth;* Henry G. Tyer and John Helm, New Brunswick, New Jersey.

Claim.—"The process of making elastic fabrics without a previous preparation of threads, strips, or sheets, or the coating of the cloth by cement."

216. For an *Improvement in Cylindrical Boxes;* Elisha Waters, Troy, New York.

Claim.—"Making the sides of said boxes of paper tubes, and the ends of wooden disks."

217. For an *Improvement in Waxing Thread in Sewing Machines;* Salem Wilder, Lynn, Massachusetts.

Claim.—"So applying the wax holder to the frame or arm of the machine, and between the needle and the eye of the needle carrier, that the vertical movements of the carrier shall cause the thread to be moved or drawn up and down through the wax holder and its elastic bottom, whereby the saturating of the thread becomes improved. Also, the combination of an elastic bottom or partition and its compresser with the wax holder, the same being to regulate the application of the wax to the thread, and to prevent its escape from the wax holder."

218. For an *Improvement in Sawing Machines;* Pinney Young, Milwaukie, Wis.

Claim.—"The employment or use of two pairs of guides secured to the ends of levers, and arranged so that said levers will be operated by the movement of the carriage, and each pair of guides brought alternately in contact with the saw near its cutting edge, the levers being operated simultaneously with the reversing movement of the carriage, for the purpose of allowing the saw to be properly guided or stayed while cutting in either direction. The combination of the toothed wheels, arms, or levers and pawls attached to plates, the arms, plates, and pawls forming a clutch, and so arranged as to operate the wheels and rotate the screw shafts, for the purpose of properly setting the log or timber to the saw, the movement of the wheels being regulated by adjusting the pins on the segments, or in an equivalent way, so as to give the required set to the log or timber."

219. For an *Improvement in Spurs;* James S. Ewbank, Assignor to Wm. Everdell, Jr., City of New York.

Claim.—"The construction of a spur having a divided hinge branch for embracing the heel of the boot or shoe. Also, the mode of sustaining the divided branches by means of the shoulder screw nut, either as constructed by having said nut with its bearing outside of the hinge of the jaws, or as sustained by means of the cone."

220. For an *Improvement in Delivering Apparatus of Grain Harvesters;* Edmund A. Morrison, Laurenceville, Assignor to self and Robert J. Morrison, Richmond, Va.

Claim.—"In combination with an endless conveying belt, with rakes thereon, and the weighted or spring door, the inclined flanch on said door under which the grain is carried and compressed, until the rake teeth come against said flanch, when the door is forced upwards on its hinges, and the cut grain delivered in compact bundles."

221. For a *Window Washer;* George A. Meacham, City of New York.

Claim.—"The arrangement of a sponge or brush at the end of a hollow handle or tube, connected by a hose or pipe to a body of water higher than the object to be washed, so that the water flows through the said sponge or brush at the very time it is rubbed or scrubbed against the window."

Re-Issue for January, 1855.

1. For an *Improvement in Mowing Machines and Harvesters;* John H. Manny, Rockford, Illinois.

Claim.—"The combination of the bar that supports the cutter with a diagonal lever held down at its inner end, and resting upon the axle of the carriage as a fulcrum, or

upon some other equivalent support that will perform the function of a fulcrum, whereby the outer end of the cutter bar is held up."

2. For an *Improvement in the Arrangement of Joints for Attaching Trucks to Harvester Frames;* John H. Manny, Rockford, Illinois.

Claim.—"The arrangement of a flexible joint in the line of the cutter, or thereabouts, in such a manner that the machine will bend freely up and down along this line to keep the cutter as nearly as may be at an uniform height from the surface of smooth or undulating ground."

3. For an *Improvement in Arrangements for Controlling Harvester Cutters;* John H. Manny, Rockford, Illinois.

Claim.—"Controlling the flexure of the machine, hinged so that it will bend in the line of the front edge of the cutting apparatus, or thereabouts, by means of an adjustable stop and arm, or their equivalents, in such manner that the cutter will be kept at the proper elevation on smooth ground, will be free to rise and fall, to conform to a gently undulating surface, and will be restrained from descending into furrows, or other sudden and narrow depressions, while it will be free to rise to any extent required for passing over boulders, stumps, or other like protuberances in its path."

4. For an *Improvement in Harvesters having a Leading Truck;* John H. Manny, Rockford, Illinois.

Claim.—"The leading carriage to carry the driver in a position in advance of the cutter, where he can readily see obstructions, and observe the character of the surface of the ground in time to adjust the machine properly for operating upon any given part of its path before reaching the same, in combination with a cutter carriage joined to the leading carriage by a hinged bar or other flexible connexion, the cutter carriage being provided with an adjusting lever or arm, and extending forward to the leading carriage, where it can be conveniently reached by the driver, to enable him to raise and lower the cutter, as required."

5. For an *Improvement in the Frame Construction of Triangular Harvesters;* John H. Manny, Rockford, Illinois.

Claim.—"Constructing the frame which supports the cutting apparatus of a triangular or trapezoidal form, one of its acute angles being at the end of the finger bar next the standing grain, so that the frame will not bear against the standing grain back of the finger bar, and will permit the wheel, which supports the outer end of the platform, to be placed a considerable distance within the end of the finger bar, yet sufficiently far from the frame, and at the same time not too far back of the centre of weight to poise or balance the machine properly."

6. For an *Improvement in Cutter Fingers of Harvesters;* J. H. Manny, Rockford, Ill.

Claim.—"Constructing the lower part of the finger, or the upper, or both, with a recess on either side in front of the finger bar, whereby the clogging of the cutting apparatus is effectually prevented. Also, constructing the finger so that the sides of its upper half will overhang those of its lower half, the cutter playing between the two. Also, beveling the upper corners of the shank of the lower part of the finger, so as to form a cutting edge thereon."

7. For an *Improvement in Harvesters;* John H. Manny, Rockford, Illinois.

Claim.—"1st, The arrangement of the track scraper at the outer end of the machine, and the wheel or wheels which support the opposite end of the machine, whether driving wheels or not, in such relative position that the wheels, while the machine is cutting one swath, will run in the track cleared by the former, while the machine was cutting a previous swath." 2d, The projection on the under side of the upper bars of the top of the finger, in combination with the chamfer or recess on the lower inside corners of said bars, to counteract the tendency of wire grass and other fibrous obstructions to pass in between the cutter bar and the sides of the recess in the upper part of the finger in which it is guided. 3d, Forming the guard finger of two parts interlocked at the point, so that grass cannot lodge in the joint and form an impediment to its entering between the stalks of the standing grain. 4th, In combination with the raker's stand or seat, I claim the removable platform or raking bottom, constructed with a wing that extends from the outer end of the cutter over the frame, and holds up the butts of the straws above the stubble, which otherwise would obstruct the discharge of the grain from the platform."

8. For *Improvements in Spark Arresters;* J. Radley and J. W. Hunter, City of N. Y.

Claim.—" 1st, The arranging of a series of chambers and channels between two conically shaped plates, the channels being so formed as to cause the products of combustion to impinge against that side of each of the dirt chambers which has the openings and caps, and thereby force the sparks, dirt, &c., into them. 2d, The piece suspended in the central aperture at the top of the spark arrester. 3d, The double cover or top for the formation of a second series of dirt passages."

9. For an *Improvement in Ploughs;* Cornelius R. Brinckerhoff, Batavia, New York.

Claim.—" 1st, Combining with the plough beam, between the plough and the forward end of the clevis, by means of a single shaft, two wheels, one on each side of the beam, and of different diameters, the one resting in the furrow and the other on the land. 2d, Making the tread of the furrow wheel narrow. 3d, Making the furrow wheel beveling outward on the side which presses against the land. 4th, Making the small wheel adjustable, with reference to the shaft or axle and the large wheel. Also, the adjustable hangers, in combination with the plough beam and axle, for the combined purpose of bracing the axle and rendering the wheels simultaneously adjustable with reference to the beam, without disturbing their adjustment."

10. For an *Improvement in Fastening Lanterns;* Chas. Monnin and Wm. M. Booth, Buffalo, New York.

Claim.—" Attaching the lamp to the lantern, by means of the combination of the catches, with the flanches and the ring to which the catches are hinged, or its equivalent, to give the hinged ends of the catches a motion concentric or parallel, or nearly so, to the side of the lantern, or the flanch through which the catches pass."

Designs for January, 1855.

1. For *Parlor Stoves;* James Wager, Volney Richmond, and H. Smith, Troy, N. Y.

Claim.—" The ornamental design and configuration of parlor stove plates."

2. For a *Cooking Stove;* Garrettson Smith, Henry Brown, and Joseph A. Reed, Assignors to J. G. Abbott and A. Lawrence, Philadelphia, Pennsylvania.

Claim.—" The design, configuration, and arrangement of the ornaments in bas-relief, on the plates of the cook stove 'Emporium.' "

3. For a *Parlor Cook Stove;* Garrettson Smith, Henry Brown, and Joseph A. Read, Assignors to J. G. Abbott and A. Lawrence, Philadelphia, Pennsylvania.

Claim.—" The design, configuration, and arrangement of the ornaments in bas-relief for a parlor cook stove."

4. For *Stoves;* Garrettson Smith, Henry Brown, and Julius Holzer, Assignors to J. G. Abbott and A. Lawrence, Philadelphia, Pennsylvania.

Claim.—"The design, configuration, and arrangement of the ornaments in bas-relief, of the stove 'Fanny Fern.' "

5. For *Lanterns;* Wm. D. Titus, Brooklyn, New York.

Claim.—" The ornamental figures on the sunken planes or faces, the beads at the sides or edges of the planes or faces, and the ornamental figures on the upper parts of the sides of the lantern."

6. For *Metallic Coffins;* M. H. Crane, Assignor to Crane, Reed & Co., Cincinnati, O.

Claim.—" The ornamental design for a metallic burial case."

7. For *Parlor Open Front Stoves;* N. S. Vedder, Troy, N. York, Assignor to G. F. Filley, St. Louis, Missouri.

Claim.—" The ornamental design and configuration of parlor stove plates."

8. For *Parlor Stoves;* N. S. Vedder and E. Ripley, Troy, New York, Assignors to G. F. Filley, St. Louis, Missouri.

Claim.—" The ornamental design and configuration of parlor stove plates."

9. For *Coal Stoves;* C. Harris and P. W. Zoiner, Cincinnati, Ohio.

Claim.—"The ornamental design for a parlor coal stove, to be known and called the 'Diadem.' "

FEBRUARY 6.

1. For an *Improvement in Smut Machines;* John Bean and Benjamin Wright, Hudson, Michigan.

Claim.—"Supplying air to the fan of a separator, the shoe of which is arranged in connexion and at right angles with a smut machine, by causing said air to pass through the smut scourers and revolving screens of said smut machine, on its way to the fan."

2. For an *Improvement in Double-Acting Force Pump;* W. C. and J. S. Burnham, City of New York.

Claim.—"Having the casing cylinder and passages arranged as shown, and cast in one piece, and secured upon the upper part of a base or circular chamber, having compartments within it, and valves upon its top plate, arranged and communicating with the several passages."

3. For an *Improvement in Manufacturing Seamless Felt Goods;* John H. Bloodgood, City of New York.

Claim.—"The method of forming the various parts necessary to the production of seamless articles of felt, by the use of a movable or stationary pattern."

4. For an *Improved Daguerreotype Plate Holder;* D. N. B. Coffin, Jr., Lynn, Mass.

Claim.—"The peculiar combination and arrangement of the block frame and bed piece."

5. For an *Improved Lifting Jack for Moving Rail Cars;* Nelson B. Carpenter and John Powers, City of New York.

Claim.—"The improved jack, constructed as herein shown, viz: connecting two ordinary screw jacks by a frame provided with an arch, and having a slide fitted on the upper part of the frame, the slide being connected to the frame, as herein shown, and operated by a horizontal screw, for raising and adjusting railroad cars upon the track, and other analogous purposes."

6. For *Current Water Wheels;* Richard Deering, Sr., Louisville, Kentucky.

Claim.—"The concave flanched screw, in combination with the conical body or centre. Also, the arrangement of hanging the water wheel, and other machinery in framing, adjustably connected with the vessel or scow, whereby they may be raised or lowered."

7. For an *Improvement in Axle Box Rollers;* G. W. Geisendorff, Indianapolis, Ind., and Jacob C. Geisendorff, Cincinnati, Ohio.

Claim.—"The giving a positive motion or rotation to the lubricating roller by the axle of the car wheel."

8. For an *Improved Corn and Cob Crusher;* John S. Griffith, Huntingdon, Penna.

Claim.—"The combination of platform, holders, and knives, arranged with the crushing frustrums and concaves."

9. For an *Improved Wire Cloth Flour Bolt;* F. B. Hunt, and Elias Nordyke, Richmond, Indiana.

Claim.—"The peculiar means for graduating the pressure of the brushes against the wire cloth of the bolt, viz: the loose hubs on the shaft being attached by arms to slides which work on the outer sides of the stationary arms, the outer ends of the slides being attached to the brush bars, which fit in the forked ends of said arms, the hubs by being moved on the shaft expanding or contracting the brush bars, the hubs being secured in the proper position by the rods."

10. For an *Improvement in Elliptical Rotary Pumps;* B. Holly, Seneca Falls, N. Y.

Claim.—"The corrugated grooved pistons or cogs."

11. For an *Improved Burglar's Alarm;* David Haldeman, Morgantown, Va.

Claim.—"Combining with the trigger lever or dog which holds the hammer at a cock, a hinged inclined lever, the end of which simply passes underneath the door, and requires no fastening other than it receives by being held by the door itself, as it is pushed open."

12. For an *Improved Machine for Repairing Roads;* A. Kimball, Fitchburg, Mass.

Claim.—"The Machine for making and repairing roads, consisting essentially of the combination of the plough and scraper suspended from the lever. Pivoting the rear axle and securing it to the frame work, in a position oblique to the direction of motion."

13. For an *Improvement in Pressing Hats and Bonnets;* S. E. Pettee, Foxboro', Mass.

Claim.—"The combination of the curved heated bed plate with the roller, for the purpose of pressing hats and bonnets, whereby I am enabled to use a rolling pressure, in contradistinction from a sliding pressure given by smoothing irons, or any other substantially the same."

14. For an *Improved Street Sweeping Machine;* Robert A. Smith and John Hartman, Jr., Philadelphia, Pennsylvania.

Claim.—"The arrangement of detachable receivers beneath the forward portion of the frame, suspended by chains attached to hooks on the receiver, from the pulleys and windlasses, so that an empty receiver may be substituted for a filled one with great facility, and the filled receiver removed by a tender. Also, constructing the rear portion of the inclined plane with wheels or rollers, and tail-piece of loose sections, so that the rear of the machine may rest on the ground, and conform to the inequalities of its surface. Further, the employment of the hinged stud, in connexion with the driving wheel and loose wheel, for operating the endless chain of brushes."

15. For an *Improvement in Steam Generators;* Wm. Mt. Storm, City of New York.

Claim.—"1st, Inclosing a thermostat in a steam-tight space, forming a part of the steam conducting passage to the engine, and from such thermostat forming an exterior and adjustable connexion to a cock or valve located in the exit pipe of the boiler in such manner that being moved by the thermostat, it shall direct more or less of the steam through the super-heater, the whole device for, by acting in conjunction thus controlling while being actuated by the temperature of the steam going to the engine. 2d, Regulating and tempering the heat in the desicator by the admission to it as may be necessary, of water from the boiler, by means of an especial communication, the quantity admitted being governable by the adjustment of a cock."

16. For an *Improved Crushing and Grinding Mill;* Joel Weigle, Swan Station, Pa.

Claim.—"Combining with the crusher and the grinder, the casings in such a manner that the said crusher and grinder can be adjusted in a longitudinal direction, and the casing of the crusher be adjusted in a lateral direction."

17. For an *Improvement in the Combined Chair and Crib for Children;* William B. Carpenter, City of New York.

Claim.—"The chair, in combination with the standards, and hinged thereto, when constructed and arranged so that by the reversal of the chair, the whole forms a high and low chair and crib for children."

18. For an *Improvement in Locomotive Trucks;* John Cochrane, Baltimore, Maryland.

Claim.—"The method of neutralizing or preventing the vibratory tendency of the trucks of locomotive engines, caused by the direct action of the forces which operate the truck driving wheels, by means of the steam or hydraulic brace."

19. For an *Improvement in Constructing Ships and other Vessels;* V. P. Corbett, Corbettsville, New York.

Claim.—"The arrangement of the india rubber, or elastic and water proof pad covering or lining on the back of the inside lining and bracing planking, and between the said inside planking and the stiffer or more solid outer timbers or frame work of the hull of the vessel, the same serving to form a stout elastic cushion or pad bearing for the inside planks to rest upon in their union to the outer frame work of the ship, and constituting a planked elastic pad inside casing to the vessel, for operation in the manner, for the better accomplishment of the several purposes of protection, freedom from injury, and facility of repair."

20. For an *Improvement in Steam Boilers;* Thomas Champion, Washington, D. C.

Claim.—"1st, Arranging an annular flue at the bottom of an upright boiler, for receiving the air at its mouth, and conducting it beneath the grate. 2d, Making the vertical tube in the form of a double cone, the upper cone being inverted, and the two united together at their apices."

21. For an *Improvement in the Manufacture of Paper Pulp;* H. Glynna, Baltimore, Md.

Claim.—"Introducing into the pulpy mass soluble soaps of wax or fats, made as set forth, converting the same into insoluble soaps within the pulp, by means of soluble salts, for the purpose of preventing forgery, mildew, and the action of insects, rats, and vermin."

22. For an *Improved Sounding Board for Piano Fortes;* J. A. Gray, Albany, N. Y.

Claim.—"The improvement of the sounding board of the piano forte, by corrugating its surface, thereby increasing its sounding surface, and giving it sufficient stiffness or strength without glueing cross bars on either side."

23. For an *Improvement in Grass Harvesters;* James H. Maydole and A. W. Morse, Eaton, New York.

Claim.—"The combination of the adjustable and controllable roller with a grass harvester."

24. For an *Improvement in Sewing Machines;* Isaac M. Singer, City of New York.

Claim.—"Imparting the feed motion to the needle to move the cloth or other substance, to determine the space of the stitches to be made therein by a feed hand, or its equivalent, receiving the required motion from the mechanism, and acting against the needle in close proximity to or in contact with the cloth."

25. For an *Improvement in Mop Heads;* James A. Taylor, Alden, New York.

Claim.—"The combination of the handle and the bars with the cord, or its equivalent."

26. For an *Improvement in Butter Workers;* J. M. Williams, Blanchester, Ohio.

Claim.—"A hollow cone, in combination with a conical roller working on its apex."

27. For an *Improvement in Grain and Grass Harvesters;* Cyrenus Wheeler, Jr., Venice, New York.

Claim.—"The combination of the double-edged cutters with the cutter bar, the braces, the vibrating cutters, and their shanks and projections, the circular ribs, the bolts, the springs, the holes, the ribs, the cavities, or their equivalents, the whole forming the cutting apparatus of the machine. The revolving or track rake, consisting of its frame, its wheel, shaft, pinions, shaft, (6), wheel, (5), teeth, apron, joint, and cap, or their equivalents."

28. For an *Improvement in Compositions for Bleaching and Stuffing Leather;* L. W. Fiske, Louisville, Kentucky.

Claim.—"The improved mode of bleaching and stuffing leather, by using the bleaching and stuffing compounds, made of the ingredients, or their equivalents, viz: clean water, sulphuric acid, dissolved alum, dissolved borax, common salt, sugar of lead, common chalk, muriatic acid, fine flour, gum tragacanth, and alcohol."

29. For an *Improvement in Working Liming Vats in Tanneries;* L. W. Fiske, Louisville, Kentucky.

Claim.—"Using a close covering for liming and unhairing vats."

30. For an *Improvement in Churns;* Hazen Webster, Ogdensburg, New York.

Claim.—"In combination with the rotary disk, that form of the agitator which occupies the central portions of the disk, and sweeps towards the circumference in a spiral shape with rounded angles, and is surmounted, towards the circumference, with one or more vertical brakers; and this I claim, whether used with or without the air passages."

31. For an *Improvement in Mechanism for Retaining Cars upon the Track;* George P. Ketcham, Bedford, Indiana.

Claim.—"The employment or use of arms applied to the axles of the trucks, the arm of each truck being supported by a rod."

FEBRUARY 13.

32. For an *Improvement in Clover Hullers;* James Allen, Trease's Store, Ohio.

Claim.—"The arrangement of the two tail-boards, in combination with the tailing screens, so arranged under the inclined board that it shall be out of the way of the blast, and yet deliver the seed into the main receptacle, and the tailings out at its side through the aperture, it being understood that the outer and inner tail-boards must be adjustable respectively with reference to the screens."

33. For an *Improvement in Machines for Chopping Meat and other Substances;* W. H. Allen, Lowell, Massachusetts.

Claim.—"Forming a machine for chopping meat and other similar substances, by attaching the chopping knives to a central rotary spindle, when this is operated by the combination of the cam and corrugated disk."

34. For an *Improvement in Hop Frames;* Thomas D. Aylsworth, Frankfort, N. Y.

Claim.—"In combination with the permanently arranged supporting cord or wire, the training cords or wires leading from the ground to said supporting wire, and connected thereto by a spring hook, or its equivalent, so as to be readily connected to or detached from the supporting wire. Also, in combination with the training cord, the inverted cup for turning down the top of the vine, and preventing it from entering the supporting wire."

35. For an *Improvement in Life Boats;* Hiram Berdan, City of New York.

Claim.—"The method of keeping the gunwale bars in place, when the boat is extended for service, by means of the notches which are made in the ribs to receive the said gunwale bars."

36. For an *Improvement in Cotton Gins;* Henry Clark, Newport, Florida.

Claim.—"The combination of a large grinding roller, either smooth or grooved, with a very small one, the latter driven and supported, as described, by the friction rollers and the large ginning roller, together with one or more stripping rollers and comb, for the purpose of removing cotton seed from the fibre."

37. For an *Improvement in Churns;* Edwin B. Clement, Barnet, Vermont.

Claim.—"The folding dasher, operating as described, viz: by working the crank forward and back it will open and fold the dasher, and describe the inside of the vessel."

38. For an *Improvement in Threshers and Cleaners of Grain;* George Daniels, Philadelphia, Pennsylvania.

Claim.—"1st, A skeleton cylinder, in combination with a cast iron bed plate. 2d, The four inclined planes placed each at an angle of forty-five degrees, and so as to leave an oblong opening between them for the passage of the grain and chaff to the receiving box. 3d, The blower case, the receiving box with its inclined plane at its end, arranged and combined on the outside of the box or body of the machine."

39. For an *Improvement in Stays for Articles of Dress;* John Dick, City of N. York.

Claim.—"The improvement in stays, as applied to articles of wearing apparel, consisting of two or more supporting pieces with a spring or springs applied to extend them."

40. For an *Improvement in Wharf Boats;* Henry T. Dexter, Zanesville, Ohio.

Claim.—"So constructing a wharf boat as that a turn-table may be conveniently located therein, upon which a dray may be driven and turned around, and so that freight may be delivered or received from any part of the boat without much handling."

41. For an *Improvement in Ploughs;* George Esterly, Heart Prairie, Wisconsin.

Claim.—"Casting the standard with raised portions, land side, and form lay, all in one piece, to be employed either with or without the projection."

42. For an *Improved Magazine Smoke Consuming Stove;* J. Esterly, Albany, N. Y.

Claim.—"Constructing the stove with openings for the admission of air to the burning fuel, at some point or points above the grate, including between said points and the grate, sufficient fuel for igniting at any one time."

43. For an *Improvement in Cracker Machines;* Phineas Emmons, City of New York.

Claim.—"The revolving intermittent bed plate, operated by means of an eccentric on a driving shaft, and the connecting rod, lever, pawls, and notched wheel in combination, and this I claim, whether the said intermittent bed plate be or be not combined with the endless band surrounding it, for the purpose of conveying away the cracker."

44. For an *Improvement in Spirit Levels;* Hampton W. Evans, Philadelphia, Penna.

Claim.—"The crescent-shaped sliding or adjustable stops and spring catch, in combination with the grooved disk and set screws, or their mechanical equivalents."

45. For an *Improvement in Steam Boiler Chimneys;* Asahel Fairchild, Ashland, O.

Claim.—"Connecting the chimney of a steam boiler furnace to the flue connecting breeching thereof, by means of a cylindrical joint arranged in such a manner that the chimney can be lowered into a horizontal position without producing openings in said joint, and also without closing the connexion between the chimney and the furnace flues."

46. For an *Improvement in Machinery for Felting Hat Bodies;* William Fuzzard, Newark, New Jersey.

Claim.—"The employment or use of the corrugated rollers placed in a swinging frame, in combination with the endless apron."

47. For an *Improvement in Rotary Ploughs;* John W. Haggard and George Bull, Bloomington, Illinois.

Claim.—"The arrangement and combined operation of the ploughs and semicircular way."

48. For an *Improvement in Weather Strips for Doors;* A. Hitchcock, Chicago, Ill.

Claim.—"The peculiar form of the elevated surface or plane, in combination with the V shaped groove, weather strip, and listing."

49. For an *Improvement in Sewing Machines;* George H. and Benjamin H. Horn, Brooklyn, New York.

Claim.—"1st, A hollow needle with an eye in the side to pass the thread. 2d, Opening the loop by means of forceps, thereby insuring that the loop is properly opened, and avoiding tangling of the thread. 3d, Drawing the shuttle through the loop by means of the eye, or its equivalent, on the end of said shuttle, thereby avoiding the risk of breaking the loop when the shuttle is forced through the same."

50. For an *Improvement in Ships' Standing Rigging;* Frederick Howes, Yarmouth Port, Massachusetts.

Claim.—"Forming the shroud and back stays, or other standing rigging, in one continuous piece, and conducting the rope of which they are formed alternately through proper guides aloft, and guides at the channels or chain plates."

51. For a *Method of Teaching Penmanship;* Wm. S. McLaurin, City of New York.

Claim.—"The employment of figures marked on or formed in the surface of a tablet, slate, or other surface, for the purpose of aiding the hand in guiding the point of a pen, pencil, or stylus, in retracing therewith the lines of the said figures an indefinite number of times, to train the hands of pupils in teaching them the art of writing."

52. For an *Improvement in Leather Splitting Machines;* Matthew H. Merriam, Chelsea, and Joseph B. Crosby, Stoneham, Massachusetts.

Claim.—"1st, The disk cutter, having a simultaneous rotary and reciprocating movement, as applied to machines for splitting leather, and other analogous purposes. 2d, Constructing the draft roller so that its increased circumferential velocity may be made to act more or less efficiently, as desired. 3d, The combination of the apron, bed, and draft rollers."

53. For an *Improvement in Grass Harvesters;* Robt. J. Morrison, Richmond, Assignor to self and Edwin A. Morrison, Lawrenceville, Virginia.

Claim.—"Constructing the cutter teeth, or blade and teeth, and the guard fingers, of three several plates of metal, all of similar form, and lying closely upon each other, the middle row of teeth being sharpened and stationary, while the upper and lower ones are vibrated, for the purpose of causing whatever slipping there may be in gathering in the stalks to be cut to come upon the fingers mainly, and thus protect the sharp edges of the cutters."

54. For an *Improvement in Lamp Extinguishers;* J. H. Noyes, Abington, Mass.

Claim.—"Attaching the caps or extinguishers to the wick tubes of a lamp, by means of rods secured to the said wick tubes, and in such a manner that the caps may be freely moved up and down the said rod, and applied to or removed from the top of the wick tubes."

55. For an *Improvement in Machines for Slaughtering Hogs;* Jefferson Parker, Louisville, Kentucky.

Claim.—"The arrangement of the elevating fingers and the chains with the operating levers, and with the scalding vessel and the scraping bench."

56. For an *Improvement in Garden Rakes;* S. N. and William F. Stillman, Leonardsville, New York.

Claim.—"The new manufacture of garden rakes, viz: a rake having curved metal teeth inserted and fastened into the head."

57. For an *Improvement in Bridle Bits;* William D. Titus and Robert W. Fenwick, Brooklyn, New York.

Claim.—"The improvement in bits for stopping running horses, consisting in the application of pads, so arranged and controlled by a rein that at the pleasure of the rider or driver, they be made to close the horses' nostrils, and thereby check respiration."

58. For an *Improvement in Ploughs;* Ira Reynolds, Republic, Ohio.

Claim.—"The laterally extending shoulders drawn back against and somewhat between the two shoulders, *r, r,* in order to hold the point securely in place, and prevent the breaking of the shank near the shoulders in the operation of ploughing. Also, the arrangement of the reversible steel share, as secured to the face of the mould board, by means of a screw bolt inserted from the lower side, the female screw being formed in the steel share. Also, the reversible self-fastening coulter."

59. For an *Improvement in Steam Valves;* John Tremper, Philadelphia, Penna.

Claim.—"1st, The valve, composed of a ring without ports or passages in its sides, applied within a casing containing a fixed head or cup, and a passage or passages leading from one side to the other of the fixed head or cup. 2d, The guard ring, applied either with or without the lip, for the purpose of protecting the inlet side or end of the valve against the percussive effect of the rush of steam or other fluid at the commencement of the stroke of the engine."

60. For an *Improvement in Head Supporters for Railroad Cars;* J. N. Williams, Dubuque, Iowa.

Claim.—"The arrangement of head supporters in railroad cars, in such a manner that each pair of supporters, by reversing their positions, can be adapted equally well to either one of the two seats nearest to said supporters when the said seat has the rear side of its back turned towards the supporters. Also, the combination of the head supporters, the plates, the bar, and the cord, or their equivalents, in such a manner that the supporters can be placed in the proper position for supporting the heads of persons riding on either one of the two seats nearest to said supporters, or turned up and secured to the side of a car."

FEBRUARY 20.

61. For a *Machine for Feeding Paper to Printing Presses;* A. B. Childs and H. W. Dickenson, Rochester, New York.

Claim.—"The raising and delivering the sheets by means of the inward and outward current being produced and operating in one and the same trunk through one and the same slit or opening, by means of the fan, or its equivalent, trunk, valve, revolving trunk, and pipe, and aperture, and, in combination therewith, we claim the outward blast produced through the trunk, by the means set forth. In combination with the inward blast through the revolving trunk for raising the paper, the outward blast through the revolving trunk for separating the sheets. Also, the projecting trunk, in combination with the main trunk. Also, the combination of the regulating and supply valve with the shut-off valve."

62. For an *Improvement in Sewing Machines;* Edwin A. Forbush, Ashland, Mass.

Claim.—"Combining with the carriage the clamps and bearer, or mechanism which draws the needle through the work, a set of pincers made to firmly grasp the thread between the needle and the work, and to be so moved away from the work as to draw the thread firmly into it. And, in combination with the said machinery for holding the needle and drawing it through the cloth or work, I claim machinery or mechanism (viz. the rotary shaft, the clamps, and the bearer, or their equivalents,) for rotating the needle, or turning or rotating it around one hundred and eighty degrees, or end for end, such

mechanism allowing me to make use of a common or ordinary needle made with one eye, and but one point. Also, the combining with the nippers and the vibrating arm, the carriages, the spring bolt, and contrivances for operating it, as set forth, the same being not only to draw the thread into the work with sufficient tension, but to do so under any change in the length of it. Also, the combination of the rotating bearer, the two needle clamps, and the vertical rotary shaft, as operating together for the purpose of holding, releasing, and reversing the needle, or turning it around. Also, to combine with the rotary bearer, and its clamps and shaft, or machinery for holding, releasing, and directing a needle into the work, a propeller operated or made to operate so as to force the needle into the work. Also, to combine with the spring nippers, or machinery for taking up the slack of the thread, and preventing entanglement of the thread while the carriages are being moved towards the work, the sliding carriage or mechanism for preventing the weight of the said spring nippers and their slide from being thrown upon the thread so as to break the needle or displace it while it is being turned around."

63. For an *Improvement in Bank Locks;* Frederick Denzler, City of New York.

Claim.—"The lever, in connexion with its spring lever, together with the dog acting upon the lever, said dog being actuated by the dog, E, for the purpose of preventing the fallar from being turned."

64. For an *Improvement in Chimney Safes;* George B. Clark, Leonardsville, N. York.

Claim.—"The smoke box or chamber, arranged in the chimney, and having dampers above, and a conical or other equivalently shaped receiver below the point or points of entry of the smoke."

65. For an *Improvement in Life-Saving Rafts;* Geo. Blanchard, Washington, D. C.

Claim.—"1st, The arrangement of the toggle or jointed levers in relation to the buoyant cylinders or floats, and the catches or locks, by which when let fall, the raft, by its own weight, is extended and locked, and made entirely ready for immediate use. 2d, The arrangement of the braces with the chains, in connexion with the floats or buoyant cylinders and jointed levers, for the better sustaining of the bed formed by the extended levers, and for the holding of the parts of the raft together in a sufficiently firm yet yielding condition to enable the raft to be a safe and well sustained life-preserving structure."

66. For an *Improvement in Metallic Springs;* Levi Bissell, City of New York; antedated August 20th, 1854.

Claim.—"The combination of the rigid bar and the thin metallic strap, with their extremities rigidly attached together."

67. For an *Improvement in Straw Cutters;* James H. Bennett, Bennington, Vt.

Claim.—"The use and arrangement of the double acting spring, in combination with the arrangement and beveled shape of the knife."

68. For an *Improved Mill Stone Dress for Hulling Rice;* C. R. Barnes, Owego, N. Y.

Claim.—"The method of dressing horizontal stones for hulling rice, the runner having curved furrows in connexion with or separate from straight furrows, and the bed stone having smaller curves drafted thereon."

69. For an *Improvement in Fluid Burners;* Yarnall Baily, West Chester, Penna.

Claim.—"The construction and arrangement of the heaters, in combination with the generator."

70. For an *Improvement in Screw Wrenches;* S. H. Noble, Westfield, Massachusetts.

Claim.—"The application of the spiral or other spring, the thumb-piece part, and the spring under the thumb-piece part, in such a manner to the common screw of screw-wrench, as to create a backward and forward self-adjusting motion of adjustable part of screw-wrench now in use."

71. For an *Improved Bullet Mould;* John S. Keith and John Brooks, Canton, Mass.

Claim.—"Combining with the mould plates the air and lead chambers, the passages, and a tube leading out of the chamber, and terminating above the level of the receiving space, above the upper mould plate. Also, the arrangement of the outer surface of either of the mould plates tangentially to the spherical or adjacent surfaces of its several matrices, or so that after the mould has been filled with metal, and the sheet of metal against the

tangential surface removed therefrom, the balls shall be left for all practical purposes, without sprues, or in a state fit for use. Also, arranging two or more sets of mould plates and their matrices together, so that the matrices of each set shall be made to respectively communicate with those of another set placed either above or below it."

72. For a *Method of Driving Pairs of Reciprocating Saws;* George P. Ketcham, Bedford, Indiana.

Claim.—"Operating the saw sashes by means of the inclined wheel or cam and lever, with its pendents or projections, the parts to be operated being connected to the ends of the lever by rods or pitmen."

73. For an *Improvement in Pump Valves;* Gustavus Hammer, Cincinnati, Ohio.

Claim.—"The manner of connecting the inducting valves of one end of a double or single acting pump with the educting valves at its opposite end, on or to a separate stem or spindle, so that each set of valves may have an independent movement of the other in its operation. Also, the combination of the two educting valves with the inducting valve, in order to give each opening an equal area with a given movement of the valves."

74. For an *Improvement in the Preparation of Paper from Resinous Barks;* Charles E. Hall, Portland, Maine.

Claim.—"The process of preparing paper pulp, using the entire substance of the bark of resinous wood, in which I retain the resinous and gummy matter within the substance of the barks, to act as a size or stiffening for the paper."

75. For an *Improvement in Harrows;* Daniel Haldeman, Morgantown, Virginia.

Claim.—"The so forming and hinging together of the frames or frame pieces of a harrow as that it may be susceptible of adjustment, and so that it may be folded up and rest upon a portion of the frame, which forms a sled upon which it may be conveyed from place to place."

76. For a *Machine for Cutting Tenons;* Joel Hastings, James Ramsey, and Henry G. Chamberlain, St. Johnsbury, Vermont.

Claim.—"1st, The arrangement of the two advancing and retiring tenon heads, the clamping piece, the dog, and the fly. 2d, The construction of the cutter stocks, and arrangement of cutters, substantially as herein set forth, to wit: the cutter stock being composed each of an open flanch, attached by a yoke or arms to its shaft, with a disk bolted to the said flanch, and having the cutters secured one to its face and the other to its back. 3d, The fly."

77. For a *Preparation of Maize-Leaf as a Substitute for Tobacco;* Joseph G. Goshon and Samuel M. Eby, Shirleysburg, Pennsylvania.

"The object of our invention is, the preparation of the leaf of Indian corn in a form similar to the various preparations of tobacco, so that it may be used instead thereof, by persons addicted to the practice of chewing and smoking, with the effect of strengthening the system instead of debilitating it."

Claim.—"Preparing the leaf of Indian corn for the above purpose."

78. For an *Improvement in Apparatus for Separating Zinc White;* Sam. Wetherill, Bethlehem, Pennsylvania.

Claim.—"The combination of the chambers, or their equivalents. Also, the method of effecting the partial cooling of the white oxide of zinc and gases, before they reach the final cooling chamber, by currents of air passing through the hollow spaces in the surrounding walls."

79. For an *Improved Griddle;* Carington Wilson, City of New York.

Claim.—"Constructing the griddle by attaching to the under side of the main plate, by casting or otherwise, the rim or flanch into which is fitted the supplementary plate, in such manner as to form an intervening space or cell."

80. For a *Water Wheel;* Thomas Tripp, Sandy Creek, New York.

Claim.—"So constructing the buckets that the direct surface (of the warped surface bucket,) shall receive the water in a direction normal to a plane parallel to the axis, and the reacting surface combined therewith, having its central line equi-distant from the axis, and at the same distance therefrom as is the central line of the direct surface."

81. For *Self-Regulating Water Gates;* George N. Todd, Dundaff, Pennsylvania.

Claim.—"Having the float attached by a chain or rod to the outer end of a lever which passes transversely through a shaft on the upper part of the flume or penstock, the inner or opposite end of said lever being attached to the gate by a chain by which the gate is raised or lowered to admit the requisite quantity of water to pass through under a variable head."

82. For an *Improvement in Feeding Flour Bolts;* Samuel Taggart, Indianapolis, Ind.

Claim.—"The combination of the annular chamber with its sweeps."

83, For *Slide Rests for Lathes;* Wm. Stephens, Richmond, Indiana.

Claim.—"Attaching the puppet head to the lathe, by having a sector frame attached to the socket or collar, and having an arm at the lower part of the puppet head, the lower end of the arm being secured to the lower end of the sector frame, and the puppet head fitting or working on the arc of the sector frame. The puppet head being operated or moved by a screw rod, or its equivalent, and secured at any desired point on the arc by a set screw, by which the puppet head may be so adjusted as to allow articles to be turned between the centres of the spindle and mandrel, as in ordinary lathes, or the puppet head be used as a slide rest for facing or cutting plates on a chuck."

84. For a *Machine for Cutting Wood into Slivers;* Samuel R. Smith and E. Cowles, Hadley, Massachusetts.

Claim.—"Giving the necessary feed motion to the cutters by means of the lever, with the segment rack attached to one end, which rack gears into the recesses cut in the lower end of the shaft. The opposite or weighted end of the lever being raised by the cord which is wound around a clutch on the shaft, motion being given the shaft by the worm wheel and screw. Also, giving the necessary motion to the cutters while passing over the 'stuff,' by means of the rim or ledge on the disk, said rim or ledge having a bent or curved portion, which, in consequence of the arm working upon it, communicates the proper motion to the cutter stocks, so that the cutters will pass over the 'stuff' in a right or straight line."

85. For an *Improved Air Heater;* William Sage, Durham, Connecticut.

Claim.—"Surrounding the chamber of combustion with series of short annular or segmental air heating compartments, which are combined with series of inclined air inducting pipes, and communicate with the hot air reservoir which surrounds said compartments, by means of the eduction apertures."

86. For *Improved Skates;* N. C. Sanford, Meriden, Connecticut.

Claim.—"Securing the runner to the stock by having disks on the upper ends of the knees, the disks being fitted within tubes or cylinders in the stock, the tubes or cylinders having a suitable elastic material within them, and their upper and lower ends covered by plates secured to the stock, whereby a requisite degree of elasticity is given the skate."

87. For *Improved Skates;* N. C. Sanford, Meriden, Connecticut.

Claim.—"Having the stock of the skate formed of two parts, and connected by a spring, when said stock is combined or used in connexion with an elastic spring runner."

88. For an *Improvement in Hand Cultivator;* J. A. Robinson, Poplin, N. Hampshire.

Claim.—"The instrument for weeding and cultivating plants in rows, the same consisting of the combination of the yoke with the knives."

89. For a *Machine for Manufacturing Hoops;* Jacob Peirson, Alexandria, Virginia.

Claim.—"1st, A vibrating or traversing frame carrying a rotary cutter, so constructed and arranged that the cutter may be made or allowed to plane or cut its full depth, or a proper depth in crooked as well as straight logs, so as to make the hoop or other article formed by the cutter, parallel or nearly parallel with the grain of the wood. 2d, In combination with the frame and cutter, I claim the circular saw, so arranged and operated as to separate the hoop or article formed from the log. 3d, In making the rests or guides which govern the position of the traversing frame, rotating cutter and saw, to traverse on the log, so as to cut the hoop or other article parallel or nearly parallel with the grain of the wood."

90. For an *Improvement in Carriage Windows;* John T. Ogden, Assignor to self and Thomas Goddard, Boston, Massachusetts.

Claim.—"The method of withdrawing the sash through the rear stile of the door, and retaining the door bolted, while the window is partially open."

91. For an *Improvement in Paint Mill;* Charles W. Brown, Boston, Assignor to Geo. W. Banker, Watertown, and George O. Carpenter, South Reading, Massachusetts.

Claim.—"1st, Attaching the trough, which receives the ground paint or material, to the running stone, so that it may rotate therewith, for the purpose of obviating the difficulty experienced in paint mills whose lower stone is the runner, of keeping the paint from running over the sides of the stone, and settling between the stone and the curb surrounding it, where it soon makes a hard bed which produces great friction. 2d, In combining with a paint trough rotating with the runner, a fixed scraper and guards, to cause the paint to flow over and out of said trough, and be guided into any suitable receptacle, whilst the mill continues to run."

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92. For an *Improvement in Piano Forte Frames;* Henry S. Ackerly, City of N. York.

Claim.—"1st, The arrangement of the wrest plank of a square piano forte along the front and across one of the front corners of the instrument, to receive two tiers of strings, of which the tier comprising the longest strings is arranged nearly parallel with the front and back of the instrument, and the shorter one diagonally across the same. 2d, The construction of the metallic plate with the straight brace across the back, and the arched moulding or brace running from the said straight brace to the front of the instrument. 3d, Constructing the plate with a recess to receive the wrest plank, so that it may be firmly secured against the tension of the strings."

93. For an *Improvement in Hotel Annunciators;* John Bale, Buffalo, New York.

Claim.—"1st, The arranging the number-plate upon the sliders, or their equivalents, in combination with the screen plate, so that the number plate shall be pushed forward, lifting the screen plate, and thus exposing the number to view. 2d, The combination of the frame, its hangings and the stops, arm, and lighters, or their equivalents, by which the wires are made to act independently of each other in striking the gong, unless the hammer shall at the instant be in active operation."

94. For an *Improvement in Gas Cooking Stoves;* James B. Blake, Worcester, Mass.

Claim.—"The method of heating the oven of a gas cooking stove, the oven being surrounded by a flue or chamber, having an opening in one end for the admission of air, for the combustion of the gas which is burned immediately beneath the oven and openings in the bottom for the escape of the products of combustion, the latter being retained in contact with the oven until sufficiently cooled to descend and pass off."

95. For an *Improved Anchor Tripper;* Samuel R. Bryant, City of New York.

Claim.—"The supporter, the pawl, and the hold-fast, as arranged in relation to the guard."

96. For an *Improved Mode of Raising Sunken Vessels;* H. V. Corbett, Buffalo, N. Y.

Claim.—"The mode of raising sunken vessels, by means of casks or buoys previously filled with air, and sunk by a weight which is readily detached and raised to the surface after the buoy is secured to the vessel."

97. For a *Method of Adjusting Cylinders in Boring Machines;* William B. Emery, Albany, New York.

Claim.—"1st, The dividing dial and its catch, in combination with the ratchet and pawl, or their equivalents. 2d, The compound dial plate and catches."

98. For a *Method of Adjusting Stuff in Planing Machines;* W. B. Emery, Albany, N.Y.

Claim.—"1st, The bed plate of iron, or other suitable material provided with teeth projecting from it, and adjusted at suitable angles, together with the wedges, or their equivalents. 2d, The bed plate and wedges, in combination with any suitable planing machine."

99. For an *Improvement in Machines for Making Chain Links;* Ammi M. George, Nashua, New Hampshire.

Claim.—"The arrangement of the forked lever confined to the arm, in relation to the inclined plane and former, and operated for relieving the former of the link."

100. For an *Improvement in Repeating Single Barrel Fire Arms;* Daniel B. Neal, Mount Gilead, Ohio.

Claim.—"1st, The combination of the elongated hammer with the false hammer. 2d, The arrangement of the lever and rod for throwing the false hammer forward."

101. For a *Fire Engine;* Amos Nudd, Exeter, New Hampshire.

Claim.—"The method of easing the motion of the brake lever, by the attachment of a crank."

102. For an *Improvement in Rolls and Driers for Paper Making;* Obadiah Marland, Boston, Massachusetts.

Claim.—"The method of making paper machine rolls and driers, a metallic foundation of the requisite strength and thickness being made use of for the body of the roll, upon which a surface of copper or other suitable metal is deposited by galvanic or electric action."

103. For *Improvements in Machines for Making Butt Hinges;* Charles Miller, City of New York.

Claim.—"1st, The arrangement of the punches which cut out two blanks to the proper shape for a hinge, and the bending rollers which give the preparatory bend to the two blanks to form the joint, whereby two strips or bars of metal fed at proper intervals of time towards each other under the said punches and through the said rollers, are cut into blanks bent and put together ready to receive the pin. 2d, Connecting together the two cutters which cut off the two blanks, and arranging and operating the said cutters so that they will cut off the blanks both at the same time, but not until they have both received the preparatory bend to form the joint, and been put together ready to receive the pin. 3d, So controlling the operations of the punches which cut out the metal blanks, the rollers which give the preparatory bend to form the joints, and the cutters which cut off the partly formed hinge from the strips, that all act during each intermission of the feed movement, but that the cutters act more quickly or earlier than the punches, in order that the preparatory bending operation which takes place after the action of the cutters may be effected before the punches are entirely withdrawn from the metal, and that the punches may serve to hold the strips during the said bending operation. 4th, The arrangement of a slider and an intermittently rotating wheel, for the purpose of removing the partly formed hinges from where they are put together and cut off, and carrying them and holding them to receive the pin and have their joints finished, to wit: the said slider working transversely to the direction in which the strips of metal move, to be submitted to the successive operations of punching, bending, and cutting off, and the intermittently rotating wheel being placed on the opposite side of the strips to the said slider. 5th, The arrangement of the wire feeding and cutting apparatus, and the press which carries the closing die, in such a manner that the horizontal intermittently rotating wheel which receives the partly finished hinges when they are cut off, may bring and hold the hinges severally and successively, first opposite the said feeding and cutting apparatus to receive the wire to form the pin, and afterwards opposite the said closing die to have the joint closed. This I claim, irrespectively of the particular means of feeding and cutting off the wire, as almost any kind of feeding and cutting apparatus may be used, and of the particular method of operating the closing die, which may be operated by any of the means commonly employed for such purposes. 6th, The eccentric curved piece, for the purpose of finishing the insertion of the pin in the hinge by pushing into the joint so much of the pin as is left protruding when the pin is cut off, said pushing being effected by the carrying wheel carrying the protruding end of the pin in contact with the said curved piece. 7th, The general arrangement and combination of the several mechanical devices and appliances to form a machine for the manufacture of hinges from bars or strips of metal, complete at one operation."

104. For an *Improved Machine for Shecoring Leather Straps;* Charles Morris, New Haven, Connecticut.

Claim.—"The combination of the knife and gauge with the swinging frame, when this frame is supported by the frame, or its equivalent, to allow this frame to yield to the varying thickness of the strap."

105. For an *Improvement in the Construction of Vessels;* Z. Pangborn, Algonac, Mich.

Claim.—"The arrangement of tanks, constructed as above set forth, the same con-

sisting in the extension and bifurcation of the ribs of vessels' hulls, so as to form an arched series of tanks or receptacles for tanks."

106. For an *Improvement in Propellers;* Franklin Peale, Philadelphia, Pennsylvania.

Claim.—"The arrangement of the paddles, the arms, and the shafts."

107. For an *Improvement in Seed Planters;* R. Romaine, Montreal, Lower Canada; patented in England, May 10th, 1853.

Claim.—"The rotary toothed cylinder, or digger, followed immediately by the seed sower and roller."

108. For an *Improvement in Hot Air Furnaces;* George S. G. Spence, Boston, Mass.

Claim.—"The carrying the smoke discharge flue of the fire chamber back through the fire chamber, whereby the draft of a long flue is promoted. Also, carrying the smoke discharge flue of the fire chamber or radiator back through the fire chamber, in combination with not only providing it with one or more orifices for the discharge of the combustible properties or gases of the smoke into the fire place, but with a diminished opening or passage, sufficient only to carry off the non-combustible volatile portions of the smoke. Also, combining with the discharge pipe and the orifice, the pipe to extend back into the discharge pipe, and with respect to the opening, the same being to facilitate the passage of the combustible gases into the fire place."

109. For a *Tenoning Machine;* William Steele, Wheeling, Virginia.

Claim.—"The arrangement of the feeding box, the rest, and their base with each other, and with the gate which carries the tenoning cutters, in such a manner that the said feeding box may be moved from the said rest upon the base the desired length of a tenon, and then be fed forward again, to bring the joist to be operated upon in contact with the cutters. Also, combining the base of the feeding box and of the rest with the frame, in such a manner that the said base, box, and rest can be secured in an oblique position to the sides of said frame, and to the direction of the movements of the tenoning cutters, whenever it may be desired to form tenons with oblique shoulders. Also, the combination of the incision cutters with the angular-edged cutters, in such a manner that the said incision cutters will penetrate into the surface of the wood in advance of the tenoning cutters a sufficient distance to prevent the said edges of the tenoning cutters from tearing out splinters from the sides of the timber operated upon."

110. For a *Bed Boat or Life Preserver;* Jos. Stevenson, Philadelphia, Pennsylvania.

Claim.—"So hanging the bulk heads or bows to a flexible boat as that they may be turned down out of the way for stowage in the bunks or berths of a vessel, and may be as readily drawn up and laced, so as to form a bow. Also, in combination with the hinged bulkheads or bows, the apron which is drawn up over the joint of the two bulk heads, for the purpose of preventing any water from entering the boat through said joints."

111. For an *Improved Stereoscope Case;* John Stull, Philadelphia, Pennsylvania.

Claim.—"Constructing a stereoscope case with the three jointed pieces, or their equivalents, so applied as to preserve at all times perfect parallelism between that part of the case containing the lenses, and the part which contains the figures, so that a perfect stereoscope is formed of the whole, and the two figures, by binocular vision, are apparently formed into a solid figure, the whole being at the same time adapted to fold or close into a small flat case, (resembling the common daguerreotype case,) that may be conveniently carried about the person, if so required."

112. For a *Machine for Cutting Barrel Heads;* Wm. L. Young, Muscatine, Iowa.

Claim.—"The centrally pressing toothed springs, and also their combination with a disk free to vibrate on its axle."

113. For an *Improvement in Forks for Gold Diggers;* L Teese & Son, San Francisco, California.

Claim.—"Making the forked tines triangular, with one side of the triangle forming the back of the tines, whether applied to more or less number of tines, or length or breadth of fork."

114. For an *Improvement in Corn Shellers;* J. P. Smith, Hummelstown, Penna.

Claim.—"1st, The breast beam, having fluted concave ribs, cross ribs, with openings

or spaces and slides. 2d, The guide frames in separate pieces. 3d, The vibrating feeder, having teeth thereon, in combination with the pulley, having a zig-zag groove."

115. For a *Mandril for Holding Carriage Hubs, &c.;* Hiram Hawley, Rome, N. Y.

Claim.—"The application of the cone-shaped cylinders, calculated for every size of box or hub, and the face end of cylinder to make the revolutions of the set invariable."

116. For an *Improvement in Hemp Brakes;* D. W. Hughes, New London, Missouri.

Claim.—"Arranging and applying the breakers so that they may be brought, while the machine is in operation, to the proper distance apart to suit the nature of the material to be operated upon, and may be caused to approach each other, or nearer to the line of operation of their corresponding breaker, as the operation progresses."

117. For an *Improvement in Looms;* William V. Gee, Assignor to the Atwater and Bristol Manufacturing Company, New Haven, Connecticut.

Claim.—"The method of forming button holes in the process of weaving suspended webbing and other fabrics, by mounting the loom with two or more sets of harness, each governing all the warp threads on one side of the intended button hole, and each set being capable of being lifted and suspended. Also, connecting each set of harness under the before named method of weaving fabrics with button holes, with a bar or slide governed by a cam and catch, or the equivalent thereof, to suspend the operation of either set of harness. Also, in combination with the before described mechanism for lifting and suspending the action of the sets of harness, or any equivalent therefor, the mechanism for determining the period of the suspension of the action of the several sets of harness, or any equivalent therefor."

118. For a *Method of Pumping Water out of Vessels;* Alexander Kirkwood, Jackson County, Mississippi.

Claim.—"The attachment of the above described pump, or of any ordinary force pump, to the bottom of a vessel, so as to force water out at her bottom, thereby avoiding the labor and expense of raising the water above the level of the water the vessel floats in."

119. For a *Spoke Machine;* Asa Landphere, Albion, Penna., and Samuel Rennington, Ilion, New York.

Claim.—"The dressing of spokes, by means of revolving cutters whose edges present an oblique profile in part of the spoke, when said cutters are so arranged on their shafts as to reduce the spoke in narrow longitudinal sections, by which means much more smooth work is obtained than when the cutters reduce the spoke at one single operation."

120. For an *Improved Method of Arranging and Operating Submerged Horizontal Paddle Wheels;* Peter Lear, Boston, Massachusetts.

Claim.—"The pipe, arranged in connexion with the wheel chamber."

121. For an *Improvement in Portable Grain Mills;* C. Leavitt, Quincy, Illinois.

Claim.—"The combination of the bed plate, the legs or supports, the breaker, and the main pivot cast in one piece, and these parts in combination with the lever attached to an external revolving concave."

122. For an *Improvement in Hulling and Cleaning Clover Seed;* Martin H. Mansfield, Ashland, Ohio.

Claim.—"The arrangement and combined operation of the screen, the endless conveyor, and the fan, in such a manner as to enable a strong blast to be employed without wasting the seeds."

123. For an *Improvement in Mowing Machines;* Fisk Russell, Boston, Massachusetts.

Claim.—"The arrangement of the secondary supporting wheel with respect to the main driving and supporting wheel, and the driving shaft, such arrangement consisting in placing the axis of the secondary supporting wheel, aside of, and not in line with, that of the primary wheel, and disposing the secondary wheel back of or on one side of the driving shaft."

124. For an *Improvement in Screw Jacks;* Thomas C. Ball, Walpole, N. Hampshire.

Claim.—"The combination of the tubular screw with the standard and the inner screw."

125. For an *Improvement in Seed Planters;* Andrew J. Barnhart, Schoolcraft, Mich.

Claim.—"The combination of the disks, movable cylinder, and piston, the above parts being inclosed or working within a cylinder or case."

126. For an *Improvement in Spade Ploughs;* David Russell, Drewersburgh, Indiana.

Claim.—"The cutter bars, said bars being provided with cutters at their lower ends."

127. For an *Improvement in Covering Thread with Wool or Silk;* John Haslem, City of N. Y., and James Haslem, Searsdale, N. Y., (sole heirs of Jos. Haslem, dec'd.)

Claim.—"The method of bedding one thread into a roving or loosely twisted thread of another material, as also the covering of one thread by a roving or loosely twisted thread of a different material."

128. For an *Improved Hand Stamp;* Daniel W. Messer, Assignor to self, R. B. Fitts, and Albert James, Boston, Massachusetts.

Claim.—"The india rubber connexion between the plate and the handle."

129. For an *Improvement in Carding Machines;* Horatio N. Gambrill and Singleton F. Burgee, Woodbury Mills, Maryland; patented in England, August 22, 1854.

Claim.—"The application of two or more sets or pairs of feeding rollers to the working cylinder of carding engines. Also, the reversing of the relative velocities of the peripheries of the main working cylinder and stripper at intervals, by an automatic movement, for the purpose of cleaning or preventing the clogging or packing of the main cylinder."

130. For an *Improvement in Fire Arms;* Jehu Hollingsworth and Ralph S. Mershon, Zanesville, Ohio; patented in England, August 1, 1854.

Claim.—"The application of a reservoir of power to the rotating of the cylinder or breech, in combination with the cocking and releasing of the hammer in concert, so as to produce two or more discharges from a repeating fire arm without replenishing said reservoir of power. Also, combining a reservoir of power with a rotating toothed 'scape wheel,' anchor, and trigger, in such a manner that at each periodical releasement of said 'scape wheel,' by the operation of the trigger and anchor, or anchor escapement, the reservoir of power will rotate the chambered breech to the required distance, and simultaneously trip an independent hammer. Also, so combining a rotating chambered breech with a reservoir of power and cock or hammer, as that by the periodical releasement of said reservoir by means of the 'scape wheel,' trigger, and anchor escapement, said chambers shall be caused to rotate to their required distance, and meet the blow of the hammer at the exact instant that each chamber in succession comes opposite the barrel. Also, combining a reservoir of power with an independent cock or hammer, so that by the periodical releasement of said reservoir of power, said hammer shall be tripped at the exact moment that each chamber of the series comes opposite the barrel. Also, so combining the stock with the frame, as that by turning said stock a spring or springs shall be wound up, which shall be capable of actuating the fire arm for a series of discharges. Also, the peculiar form of guard or protection to the hand on which the fire arm may be supported, so as to guard the hand from any accidental discharge of the chambers when not opposite the barrel, whilst said accidental discharge may escape from the fire arm without detriment to the user. Also, the conical plate and ring, as a means by which the stock and spring box are united to the frame, so as to make a firm connexion, and at the same time allow the one to be turned upon the other, for the purpose of coiling up or compressing the spring."

131. For an *Improvement in Repeating Fire Arms;* Ralph S. Mershon and Jehu Hollingsworth, Zanesville, Ohio; patented in England, August 1st, 1854.

Claim.—"1st, A reservoir of power capable of discharging two or more barrels or chambers of a repeating fire arm. Also, exploding the cap, or similar percussion priming for discharging the chamber, by means of the blow caused by the rotation of the chambers or barrels, bringing each nipple or cap in succession against a vibrating arm, or its equivalent, thus causing said rotation to perform the ordinary function of a cock or hammer. Also, so hinging the barrel, or frame which supports it, to the stock, as that when said barrel is swung back or forward, either for removing or recharging the chambers, it will contract the spring to supply a reservoir of power capable of discharging two or more chambers or barrels successively, without re-cocking or re-charging at each discharge."

ADDITIONAL IMPROVEMENT.

1. For an *Improvement in Seed Planters;* J. Graham Macfarlane, Perry County, Pa.; additional to Letters Patent granted March 14, 1854; dated February 6, 1855.

Claim.—"The attaching the box or hopper to the beam and handles, by means of holes left in casting the box, or any equivalent device. Also, in placing the bottom of the lime box below the slide, for the purpose of preventing the lime choking the machine and impeding its action."

RE-ISSUES FOR FEBRUARY, 1855.

1. For an *Improvement in the Mode of Constructing a Combined Cauldron and Furnace, for the use of Agriculturists and others;* Jordan L. Mott, Mott Haven, New York; original patent dated December 1st, 1840; Extended December 1st, 1854; re-issue dated February 6th, 1855.

Claim.—"Combining a cauldron with a portable furnace, having a fire chamber of smaller size than the area of the cauldron, by spreading out and extending the sides of the furnace to form an outer casing, partly or wholly surrounding the cauldron, and forming a flue space between the two leading to the exit pipe. Also, making the casing to form the flue space around the cauldron, by elevating and spreading out the plates of the furnace, and fitting to and combining therewith sectional side pieces."

2. For an *Improvement in Candlesticks;* John W. Rockwell, Assignee of Francis A. Rockwell, Ridgefield, Connecticut; original patent dated Dec. 16th, 1851; re-issue dated February 27th, 1855.

Claim.—"The employment of elastic packing attached to the standard, bar, spring, or slide of a candlestick, whereby I am enabled to support said part, prevent the leaking of the grease, and use a shorter sliding socket than when the cork is inserted loose in the socket."

DESIGNS FOR FEBRUARY, 1855.

1. For *Stoves;* S. W. Gibbs, Albany, New York, Assignor to North, Chase & North, Philadelphia, Pennsylvania; dated February 20th, 1855.

Claim.—"The ornaments and mouldings."

2. For *Cooking Stoves;* S. W. Gibbs, Albany, New York, Assignor to North, Chase & North, Philadelphia; dated February 20th, 1855.

Claim.—"The ornaments, flutings, and mouldings."

3. For *Daguerreotype Cases;* H. A. Eickmyer, Philadelphia, Pa.; dated Feb. 27, 1855.

Claim.—"The construction of a case for daguerreotype or other purposes, rounded on its front and back edges, and banded."

4. For *Stoves;* John Haufbaner and H. Waas, Cincinnati, Ohio; dated Feb. 27, 1855.

Claim.—"The combination of the different ornaments."

MECHANICS, PHYSICS, AND CHEMISTRY.

Translated for the Journal of the Franklin Institute.

A New Diamond from Brazil. By M. DUFRENOY.

M. Halphem has recently received from Brazil, a diamond very remarkable both for its size and for the perfection of its crystalline form. As soon as it appeared in commerce, it fixed the attention of lapidaries, who, to distinguish it from known diamonds, have called it the *Star of the South.*

The *Star of the South* weighs 52·275 grms., corresponding, in the language of lapidaries, to 254½ carats; by cutting, this diamond will

lose nearly one-half of its weight, and will then be reduced to about 127 carats.

This weight will still place it among the four or five most precious diamonds known.

The Ko-hi-noor weighs from 120 to 122 carats.

The *Star of the South* will, in the opinion of lapidaries accustomed to judge of the water of a diamond while it is yet rough, be perfectly limpid, and will have the peculiar lustre which gives to diamonds so high a value.

The general form of the *Star of the South* is a rhomboidal dodecahedron, beveled very obtusely on each face, and consequently having a solid form of twenty-four faces. The faces are rough as though shagrined. Light striæ in the lines of octohedral cleavage, which distinguish the diamond as a mineral species, are also observable.

Its specific gravity is, according to M. Halphem, 3·529 at 15° Cent.

Upon one of the faces of the diamond is seen a cavity of considerable depth, which may be recognised as due to an octohedral crystal formerly implanted upon it. The interior of this cavity, when examined by a magnifier, shows octohedral striæ; no doubt, therefore, that the crystal which has thus left its trace, was a diamond.

On the posterior part of the crystal, two other cavities of less depth are seen, also bearing the octohedral striæ on their surface; one of these shows traces of three or four crystals. On the same side of the crystal is seen a flat portion, where the cleavage may be seen. I am much inclined to regard it as a fracture; perhaps the point of attachment of this diamond to its gangue, whence it has been detached by the diluvial phenomena which have carried it off.

In addition, I will call attention to some black scales which appear to be titaniferous iron, a mineral frequently associated with crystals of quartz in the Alps and in Brazil.

From all these facts it results, that the *Star of the South* has originally belonged to a group of crystals of diamond, analogous to those of quartz, Iceland-spar, iron-pyrites, and most crystallized minerals. The diamond will then be found lining geodes, in the midst of certain rocks, as yet unknown to us, but belonging, according to the observation communicated to the Academy in 1843 by M. Lomonosoff, to the metamorphic rocks of Brazil. This must be its true position, and in this respect the formation of diamonds will be analogous to that of most other crystals, especially with the formation of geodes seen in the marble of Carrara.

The *Star of the South* was found, at the end of July, 1853, by a negress employed in the mines of Bogagen, one of the districts of Mines-Geraes. It is the largest diamond which has come to Europe from Brazil; the most celebrated diamonds heretofore being from India.—*Acad. des Scien., Paris, January,* 1855.

Translated for the Journal of the Franklin Institute.

New Water-Proofed Stuffs.

The *Societè Philomathique* of Bordeaux, publishes a very favorable report from its Committee, on the water-proof stuffs of M. Fritz Solier.

The tissues of M. Solier are prepared not with natural caoutchouc, but with artificial caoutchouc, of which MM. Barrat have made so many successful applications, and which is prepared by oxidizing drying oils either directly or by aqua fortis. Nothing is more permanent or more workable than this remarkable substance, said to have been discovered by Liebig. To convert it into a material fitted to be used as a coating for stuffs, M. Solier mixes it with a certain quantity of resin-oil, purified by the process of M. Mangeot. The stuffs coated with it are perfectly impermeable, supple, light, and unalterable by light or air; and what is their greatest merit, may be made astonishingly cheap. They are accessible to the poorest classes; and thanks to them, the humblest laborers in our fields will not be exposed hereafter to suffer from the weather. The most delicate silk and the coarsest woolen fabric are alike susceptible of this preparation.—*Cosmos*, vol. v. p. 570.

Translated for the Journal of the Franklin Institute.

On the Mechanical Equivalent of Heat. By M. Person.

The mechanical equivalent of heat, that is to say, the work done by an unit of heat, if there be no loss, has been very differently estimated. M. Mayer found it to be 360 kilogrammètres, M. Laboulaye 110, and M. Joule 427. Lately M. Estocquois, my colleague in the Faculty of Sciences, obtained the number 175, in a Memoir which he had the honor of presenting to you.

We shall have the exact number, when we know exactly the specific heat (c) of air, under constant volume, or rather without external resistance. But, in the meantime, it is perhaps worth while to remark, that the value of c deduced from the formula of Laplace for the correction of the velocity of sound, gives for the mechanical equivalent of heat a number differing very little from that assigned to it by M. Joule.

Air which dilates without external resistance, recovers in a few moments its primitive temperature, and contains, despite its dilatation, neither more nor less heat than before. This principle, as to which doubt might still have been entertained even after the experiments of M. Joule, is now perfectly established by the last experiments of M. Regnault.

Starting from this principle, the mechanical equivalent of heat is deduced by very simple reasoning. Let us consider one cubic metre of air at $0°$ temperature under the normal pressure (H) kilogrammes per square metre; let p be its weight, c its specific heat under constant volume. If we give to this air the heat pc, without suffering it to dilate, the temperature will rise one degree, and the pressure will become (Ha,) (a being the cofficient 0·00367.) Let us now open a communication with a vacuum; we shall have the same temperature, and the same quantity of heat, in spite of the dilatation, and if the vacuum is equal to the fraction a of a cubic metre, the pressure will become H again.

Let us now take a cubic metre of air, at the temperature $0°$, and under the pressure H, c designating its specific heat under constant pressure;

give to this air the heat pc, permitting it now to dilate under the pressure which it supports; we thus obtain a volume Ha at 1° under the pressure H, precisely as in the last case, where, however, we only introduced the quantity of heat pc. In the first case no external work was done, whilst in the second, the dilatation a against the resistance H, produced the work aH. As these two messes of air were identical at the beginning, and are so at the end, neither of them contain more or less heat than the other. We may therefore conclude that the heat $p\,(\mathrm{c}-c)$ is *alone and entirely* employed in producing the work aH. Therefore, the work done by an unit of heat is measured by $\dfrac{a\mathrm{H}}{p\,(\mathrm{c}-c)}$.

Substituting the numbers $\mathrm{H}=10334^{\mathrm{k}}\cdot$ $p=1^{\mathrm{k}}\cdot 293$. $c\left(\dfrac{279}{333}\right)^2=0\cdot 1686$, according to Laplace, and $\mathrm{c}=0\cdot 2377$, according to M. Regnault; we find 424 kilogrammètres for the mechanical equivalent of heat.

Observe, that $p\,(\mathrm{c}-c)$ is the difference of two specific heats for equal volumes. Now, according to Dulong, this difference is the same for all gases, simple or compound. This accords very well with the idea of invariability which attaches to the mechanical equivalent of heat. But, as M. Regnault has demonstrated that a is not rigorously the same for all gases, it follows that $p\,(\mathrm{c}-c)$ must vary proportionably by a very small amount. We may, moreover, assume that the specific heats have been measured so far from the point of liquefaction that there is no change in molecular constitution, so that the effects of the heat are confined to variations of temperature, and extraneous work.—*Acad. des Scien., Paris, December*, 1854.

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*Photographic Pictures on Stone for Lithographic Printing.**

In France, the fascinating art of photography has for some time been applied in the process of multiplication by printing on stone, and hence its industrial value has been increased by one great step beyond what we have achieved here. Messrs. Lemercier & Co., of Paris, who have carried this art to great perfection, give the following instructions for practising it. To obtain a photographic picture on stone, in a manner suitable for lithography, a substance must be had which can be placed upon a stone in a regular and uniform film, and which can be acted upon by the light in such a manner that the lights of the picture may be dissolved away and the half tints separated, whilst it must adhere to the stone sufficiently to prevent its being removed either by the solvent or by the subsequent printing process, it being, of course, capable of taking the lithographic ink. The bitumen of Judea, first employed by Niepce, is considered to possess all the requisite properties. It is, however, necessary to select the bitumen very carefully, as some samples are far more susceptible to the action of the light than others. A small quantity of the bitumen, reduced to a fine powder is dissolved in ether, the solution being so made that when it is spread upon the stone it will lie in a

* From the Lond. Pract. Mechanics' Journ., February, 1855.

very thin film, not, however, like a varnish but having a fine grain, and so that on being examined with a magnifying glass the bare stone will be seen in the interstices of the grain. The fineness and regularity of this graining, upon which the excellence of the result materially depends, is obtained by a careful adjustment of the heat of the stone, which should be such as to cause a rapid evaporation of the ether—and by nicety in the preparation of the solution. Whilst the bituminous film is being put upon the stone, it is necessary to avoid all motion of the atmosphere, as caused by the breath or by quick movements of the person, as anything of this kind will make the thickness of the film unequal. When ready, the prepared stone is placed behind a photographic negative on albuminized or collodionized glass, and is then exposed to the light, the duration of this exposure being only ascertainable by practice. If the exposure has been too short, the picture on the stone will be too faint and wanting in the half tints, whilst if the stone is exposed too long a time, the picture will be heavy and devoid of all sharpness and effect. After this, the soluble portions of the bituminous film are washed away by ether, which must be used in excess, otherwise it is very apt to form spots and marks which cannot be got rid of.

When the washing or development of the picture is completed and the stone dried, it is treated in exactly the same manner as a crayon drawing on the stone, that is to say, with an acidulous gummy solution, to clear the whites and increase the transparency of the picture. After this, it is well washed with pure water and essence of turpentine, and it is finally inked with common lithographic ink. If the stone is well prepared it should take the ink at once without any retouching being required, and it will print like a common lithographic stone, the impressions improving as the printing goes on, and the stone will give as many impressions as a common lithographic stone.

Translated for the Journal of the Franklin Institute.

Mode of producing Alcohol from Vegetable Fibre, and especially from Wood. By M. J. Ed. Arnoud.

Under present circumstances, when the manufacture of alcohol is becoming so extensive that it diverts many first materials, especially the cerealia, from their true and more useful employment, I have thought it would be of interest to present to the Academy the results of some researches on a new mode of producing alcohol, although these researches are not yet complete.

Starting from the labors of M. Braconnot, published thirty-five years ago, and upon those more recent, of M. Payen, I undertook to produce a material analogous to starch, sugar, and alcohol, from vegetable fibres, and particularly from wood. My first attempts have fully answered my expectations. I have succeeded, with certain substances, in rendering soluble 97 per cent. of the substances employed, and with certain kinds of wood, in converting into sugar and then into alcohol, from 75 to 80 per cent. of the wood used.

The wood is reduced to coarse saw dust; in this state it is dried up

to a temperature of 100°, (212° Fah.,) so as to drain off the water which it contains, often amounting to one-half of its weight. The wood is then suffered to cool, and concentrated sulphuric acid is poured over it with great care, and very small quantities at a time, so as to prevent the materials from heating. The acid is mixed with the wood as it is poured; then for twelve hours the mixture is let alone; after that it is rubbed up with great care, until the mass, which is at first dry, becomes sufficiently liquid to run. This liquid, diluted with water, is brought to ebullition; the acid is saturated with lime, and the liquid, after filtration, is fermented, and the alcohol distilled in the ordinary way.

In this experiment, the sulphuric acid must be at least 110 per cent. of the weight of the dry wood. Experiments now on hand lead me to hope that the quantity of acid may be considerably diminished; but even now, even with a higher proportion, the manufacture of alcohol would be economical, in consequence of the low price of the matters employed, to wit: wood, chalk, and sulphuric acid.—*Academy des Sciences, Paris, October 23d,* 1855.

For the Journal of the Franklin Institute.

Performance of the U. S. Steamship Susquehanna, during her Employment in the Japan Squadron.

By the kindness of one of the engineers who has been on board of this ship during her entire cruise, we are enabled to present to our readers an abstract of her whole performance, which comprises an amount of steaming probably never before equalled during one cruise by any steamer in the world.

The particulars of the *Susquehanna* were published in this *Journal*, in October, 1852, (vide vol. xxiv., pp. 251–6,) but her principal dimensions may be recapitulated. *Hull*, 257 feet long between perpendiculars, 45 feet beam, 26½ ft. hold, 2452 tons Custom House measurement. *Engines*, two inclined cylinders, 70 inches diameter, 10 feet stroke, poppet valves, Stevens' cut-off gear, arranged to cut off at 5 feet, and not adjustable. *Wheels*, 31 feet diameter, 9 feet 6 inches face, 26 paddles 34 inches wide, average dip, 5 feet to 5 feet 6 inches. Space occupied by engines and boilers in length of vessel, 90 feet. Total, with 900 tons of coal, 102 feet 9 inches in length.

The *Susquehanna* was, for a time, the flag ship of the Japan Squadron, to which she belonged since her departure from Norfolk, in June, 1851, and on which service she has been employed for three years and eight months, having returned to Philadelphia in March, 1855. During her cruise she has circumnavigated the globe under steam, a feat never before performed; has been in motion 340 days, during which the engines were in continuous operation, except for about ten days; has steamed and sailed over 60,000 miles, and has consumed over 11,000 tons of coal. For the whole time during which she was in motion, her mean speed was $7\frac{5}{10}$th knots per hour, with an average hourly consumption of $1\frac{35}{100}$th tons of coal; and the following tables will show the uniformity of results attained during the outward and homeward passages, as well in speed as in consumption of fuel and slip of the wheels:—

Abstract of Log of U. S. Steamship Susquehanna, including her entire performance for the period between her departure from the United States and return to the same, while in service in the Japan Squadron.

DATE.		PLACES.	DISTANCE RUN UNDER			Revols. of Engines.	TIME UNDER									Coal in Tons.
			Steam.	Sail.	Both.		Steam. days.	hs.	min.	Sail. D.	H.	M.	Total. days,	hs.	min.	
Dec. 26 to 28,	1850.	Philadelphia to Norfolk.	300	. .	300	26,890	2	19	50	.	.	.	2	19	50	95
June 8 to 25,	1851.	Norfolk to Madeira.	3040	. .	3040	254,788	16	8	10	.	.	.	16	8	10	632
July 5 to 26,	"	Madeira to Rio. •	2750	1106	3856	205,935	13	19	15	7	0	0	20	19	15	522
September 27 to Oct. 15,	"	Rio to Cape of Good Hope.	3598	. .	3598	257,633	17	22	25	.	.	.	17	22	25	487
October 29 to Nov. 15,	"	Cape of Good Hope to Port Louis.	2957	. .	2957	219,473	15	19	50	.	.	.	15	19	50	480·5
November 23 to Dec. 2,	"	Port Louis to Zanzibar.	1431	. .	1431	102,776	8	2	00	.	.	.	8	2	00	142
December 8 to 28,	"	Zanzibar to Point de Galle. Ceylon.	2868	. .	2868	235,222	16	21	25	.	.	.	16	21	25	395·5
January 3 to 12,	1852.	Ceylon to Panang.	1551	. .	1551	130,210	9	2	40	.	.	.	9	2	40	329
January 18 to 20,	"	Panang to Singapore.	466	. .	466	31,724	1	18	00	.	.	.	1	18	00	83
January 25 to Feb. 4,	"	Singapore to Macao.	1802	. .	1802	148,261	10	00	00	.	.	.	10	00	00	566·5
		Cruising.														
February 28 to May 22,	"	" Macao and Hong Kong.	325	. .	325	20,369	1	5	40	.	.	.	1	5	40	81·5
May 29 to June 4,	"	" Hong Kong and Amoy.	736	. .	736	51,852	2	7	15	.	.	.	2	7	15	159
		" Hong Kong and Blenheim, &c.	788	. .	788	67,255	2	21	35	.	.	.	2	21	35	166
December 24 to 27,	"	" Amoy and Manilla.	636	. .	636	46,822	3	1	8	.	.	.	3	1	8	118
January 27 to 31,	1853.	" Manilla and Hong Kong.	725	. .	725	55,498	3	19	50	.	.	.	3	19	50	165
February 29 to March 5,	"	" Hong Kong and Macao.	160	. .	160	10,536	0	16	25	.	.	.	00	16	25	44
March 20 to 27,	"	" Hong Kong and Shanghæ.	925	. .	925	85,899	5	9	20	.	.	.	5	9	20	254·5
April 1 to May 19,	"	" Yang Tse Kiang.	215	. .	215	4,400	0	18	00	.	.	.	00	18	00	70
May 23 to 26,	"	" Yang Tse Kiang & Loo Choo.	466	. .	466	35,371	2	12	00	.	.	.	2	12	00	94
June 9 to 14,	"	" Loo Choo and Bonin.	946	. .	946	61,936	5	00	00*	.	.	.	5	0	00	129·5
June 18 to 23,	"	" Bonin and Loo Choo.	898	. .	898	68,852	5	8	00*	.	.	.	5	8	00	130·5
July 2 to 8,	"	" Loo Choo and Japan.	1019	. .	1019	73,890	6	00	00*	.	.	.	6	0	00	184

July 14 to 25,	1853.	Cruising. Japan to Loo Choo.	1409	. .	1409	95,449	8	18	0	.	.	.	8	18	0	274
August 1 to 7,	"	" Loo Choo to Hong Kong.	1169	. . .	1169	86,700	6	12	0	.	.	.	6	12	0	217
		"	250	. .	250	15,994	1	1	40	.	.	.	1	1	40	78
January 14 to 21,	1854.	" Hong Kong to Loo Choo.	1036	. .	1036	80,687	7	12	0	.	.	.	7	12	00	216
February 7 to 13,	"	" Loo Choo to Japan.	865	. .	865	68,754	5	4	15	.	.	.	5	4	15	193
February 24 to 27,	"	" Jeddo Bay.	40	. .	40	4,120				.	.	.				15
March 24 to April 2,	"	" Japan to Hong Kong.	1609	. .	1609	140,360	9	4	27	.	.	.	9	4	27	214
April 13 to 18,	"	"	200	. .	200	13,000	0	21	50	.	.	.		21	50	49·5
April 20 to 26,	"	" Hong Kong to Shanghæ.	842	. .	842	78,100	5	0	0	.	.	.	5	0	00	233
		"	825	. .	825	57,536	3	3	10	.	.	.	3	3	10	178
May 20 to June 4,	"	"	497	. .	497	40,070	4	18	0	.	.	.	4	18	00	125
August 1 to 10,	"	"	540	. .	540	139,730	4	15	0	.	.	.	4	15	00	125
August 11 to 17,	"	"	200	. .	200	17,230	1	1	15	.	.	.	1	1	15	54
September 4 to 15,	"	Hong Kong to Simoda.	1609	. .	1609	122,323	10	18	0†	.	.	.	10	18	00	313
September 24 to Oct. 18,	"	Simoda to Honolulu.	3878	. .	3878	285,704	24	1	20	.	.	.	24	1	20	555
October 30 to Nov. 12,	"	Honolulu to San Francisco.	2319	. .	2319	181,698	12	0	29	.	.	.	12	0	29	476
November 25 to Dec. 5,	"	San Francisco to Acapulco.	1837	. .	1837	150,130	9	19	30	.	.	.	9	19	30	363·5
Dec. 12, 1854, to Jan. 1,	1855.	Acapulco to Valparaiso.	3423	. .	3423	295,391	19	21	10	.	.	.	19	21	10	700
Jan. 14 to Feb. 4,	"	Valparaiso to Rio Janeiro.	3917	. .	3917	301,018	21	1	55	.	.	.	21	1	55	697
February 11 to March 9,	"	Rio Janeiro to Philadelphia.	3984	972	4956	302,405	21	1	0	5	14	0	26	15	11	637
Totals, - -			59051	2078	61129	4,439,991	328	19	49	12	14	0	341	9	49	11041·5
		Outward, - -	20763	1106	21869	1,612,912	112	13	35	7	0	0	119	13	35	3732·5
		Cruising, - -	17321		17321	1,192,410	96	14	50				96	14	50	3567·5
		Homeward. - -	20967	972	21939	1,638,669	118	15	24	5	14	0	124	5	24	3741·5

* *Saratoga* in tow.

† *Southampton* in tow one day.

Abstract of Performances under Steam alone, and assisted by Sail.

	PER HOUR.			PER KNOT.		WHEELS.	
	Speed in knots.	Coal in lbs.	Rev's. of eng'es.	Rev's. of eng'es.	Coal in lbs.	Rev's. per min.	Slip in per cts.
Outward Passage,	7·656	3084	594	77·7	403	9·90	16·5
Homeward "	7·365	2944	575	78·1	400	9·58	17·1
Mean,	7·510	3014	584	77·9	401½	9·74	16·8

In the foregoing table, the performance in cruising has not been included, owing to the short passages, &c., requiring an undue consumption of fuel from lighting and extinguishing fires, &c., and to a want of knowledge of the influence of tides and currents. But the above covers a period of 231½ days, and certainly presents a remarkable economy and uniformity.

We hear much said of the slowness of our naval steamers, of their inefficiency, &c., and as it must be admitted that great cause for complaint has existed, it gives us pleasure to record such a log as the above. The *Susquehanna*, on her return, made the passage from Valparaiso to Rio de Janeiro, *around Cape Horn*, in 21 days and 2 hours, the quickest passage yet made. The run from San Francisco to Philadelphia in 77⅓ days, of which for 5½ days the ship was under sail and the paddles off; the average speed for that time being about 180 miles in 24 hours. The highest speed attained during any 24 hours, was 251¼ knots.

In considering the above consumption of fuel, it ought in justice to be remarked, that the cut-off was set at half stroke and not adjustable, and that the boilers have for a long time been in a very leaky condition, both of which tended to increase the expenditure of coal. J. V. M.

On the Action of the Violet and Ultra-Violet Invisible Light.

By W. Eisenlohr.*

The phenomenon described by Stokes under the name *fluorescence*, led me to the supposition that this was caused by the interference of the shorter system of waves, blue-violet and ultra-violet (for the sake of shortness, the chemically acting invisible rays of the spectrum may be so designated). I think, with many others, that the eye has the greatest sensibility for a certain duration of vibration, (the yellow light,) and that it is the more sensitive for longer or shorter waves, the more these differ from the medium light in their depth or height.

Light itself consists of the visible systems of waves, and besides these, of such as are longer than red and shorter than violet. As the combination of two tones is always deeper than each single one, out of which the compound tone arises, so from the interference of yellow and blue there can result only light of greater length of undulation, and not violet light. Now, since red has the longest undulations of the visible light, the com-

* From the Lond., Edin., and Dub. Philos. Mag., Feb. 1855.

bination of red and yellow waves of light can only give a deeper tint than red, and consequently no visible light. A fluorescence in the dark space of the spectrum near the red is not therefore to be expected. It is quite otherwise at the other end of the spectrum. The ultra-violet is the light acting in the dark space of the spectrum near the violet; its existence could only be shown by its chemical action, before the wonderful discovery of Stokes. It consists of countless systems of undulations, the lengths of which, differing among themselves, have all a shorter duration than the violet light. Through their interference, waves of greater length than their own results; and by their great variety, tints of combination no less numerous; hence, in many cases, all kinds of visible light, or white.

In other cases a certain color prevails in the mixture of the tints of combination, which will partly arise from the length of the original waves, and partly from the distance of the reflecting layers of atoms of the fluorescent body.*

Starting from this view, I have made experiments to find sources of light in which high tints prevail, in order to test this idea. Violet and blue glasses, through which the sunlight was admitted into the room by means of a heliostat, separating single parts of the entire spectrum from the rest, and causing the light thus obtained to penetrate into the fluorescent bodies, proved, at least, not the contrary of my supposition. I ascribe the cause of the partially slight success to the circumstance, that I possessed no blue and violet glasses of sufficient purity, which on that account allowed fewer of the more intensely acting rays to pass through. At last the violet light occurred to me, which results in the so-called electric egg when it is exhausted of air. I tried its action on fluorescent bodies, and was delighted to see that it produced some of the appearances described by Stokes, with a splendor which I have never seen with the most beautiful experiment by means of the spectrum. Paper on which a design had been made with a solution of sulphate of quinine, showed at a distance of ten to twelve feet from the oval receiver in the dark chamber, all the details of the design in the most beautiful white on a *deep* violet ground. Ruhmkorff's induction apparatus is extremely convenient for the production of the electric light in the receiver, when the latter is almost exhausted of air. The appearance is so striking as to lead to the belief that the writing or design on the paper is itself shining and sparkling.

Hence, in my opinion, it follows, 1st, That the violet light produced *in vacuo* is mixed with a large quantity of invisible ultra-violet rays. 2d, That out of the ultra-violet rays of the so-called northern light invisible to the naked eye, there results by interference in fluorescent bodies a quantity of visible light, and that therefore this light, reflected from the surface of the paper which has been marked with quinine solution, appears brighter than direct light; that therefore, out of the ultra-violet light invisible to the naked eye, there is produced by mechanical means

* Of course, the comparison between the tone of combination, and the light produced by various kinds of ultra-violet or other waves, must not be taken literally, for otherwise the number of vibrations of the resulting color must be equal to the difference in the number of vibrations of the original rays.

actual light. 3d, That the so-called northern light has the strongest chemical action.

A further conclusion is, that the light *in vacuo* of Ruhmkorff's apparatus, or even that of the electric machine, is a much more powerful agent for testing the fluorescence of bodies than any hitherto employed.

I may here mention that I am still engaged on this subject, and reserve to myself further communications. The short time at my disposal compels me to limit myself to the statement, that a thick white glass in the dark chamber appears of a clear and splendid gray.

I scarcely doubt that the white *color* of the electric light in air has also its explanation in the combination of the higher systems of waves, which are formed in consequence of the manifold reflexion on the atoms of air, and the consequent interference. Even the sun's rays are, according to Sondhaus, violet, and we see the sun, as it appears to us, only through a mixture of tints, whose production can be explained by the combination of the shorter systems of rays of the violet light.—*Poggendorff's Annalen*, vol. xciii., p. 623.

On the Incrustation of Steam Boilers. By M. Couste.*

In the *Annales des Mines* for the present year, is an interesting paper by M. Cousté on the incrustations of steam boilers, and the methods for preventing their formation. He commences by pointing out that the prevention of incrustations, if realized, would produce a better preservation of the boilers, greater security against explosions, and considerable economy in fuel. For steam vessels, it would be attended with an increase of available space for cargo, and the use of steam at high pressure.

He then presents the results of his investigations on the nature of deposits, and the circumstances connected with their formation, whether in boilers fed with salt or fresh water.

M. Cousté suggests four methods for preventing incrustations. The first is, in fact, the well known method, which consists in extracting from the boiler, either at intermittent periods, or in a continuous manner, a certain quantity of water saturated with solid matter. He thinks this process imperfect for low pressure engines, and quite useless for those at high pressure. He proposes, however, to make some further improvements in it, as the greater number of marine steam engines work at low pressure, and may thus be in some measure benefited.

The second of the methods described is called by M. Cousté, *alimentation nonhydrique*, and requires the use of Hall's condensers. The principal objection to this method is the existence of a counter pressure in the cylinder during too considerable a part of the stroke of the piston. By calculation he finds that from about 25 to 30 per cent. of force is lost in a low pressure engine.

The third method consists in continually employing the same water for condensing the steam, and of course requires that this water must continually pass through a refrigerating process.

The fourth method, which belongs entirely to M. Cousté, consists in feeding the boiler with water heated to a very high temperature (at least

* From the London Mechanics' Magazine, January, 1855.

318° Fahr.,) before being introduced into the boiler. This process has the effect of completely precipitating all the calcareous salts held in solution by the water.

The process requires a special heating apparatus, and a filter for separating the precipitate. The author remarks that the filtering which is necessary for engines at ordinary or low pressure, or for high pressure engines working occasionally, might be dispensed with for marine high pressure boilers, because the salts precipitated in the heater cannot again dissolve in the boiler, and consequently cannot crystallize, but will only form a muddy deposit instead of a fixed incrustation.

Finally, in comparing these different methods, M. Cousté thinks the last should be preferred for navigation, whether in salt or fresh water, and exclusively employed for locomotives; while the third more cumbrous method could be advantageously used for land engines under certain locally favorable conditions.

In order accurately to estimate the value of keeping the surfaces of boilers clean and free from incrustation, M. Cousté has mathematically investigated the loss of heat which takes place in causing the water in an incrusted boiler to arrive at a given temperature. He does this by comparing two boilers of the same shape and dimensions, placed under precisely the same conditions, except that one is covered with a calcareous incrustation all over its heated surface, while the other was free from deposit, and covered only with a thin coat of rust. They are supposed to be so managed as to produce equal quantities of steam in equal times. It follows that the heat of the fire under the incrusted boiler must be increased; hence a great loss of heat by the rarefied air and gas escaping through the chimney, and by the external radiation from the furnace. The first of these causes of loss is, of course, the most considerable, and it is it alone that the author has sought to estimate. This he does by the aid of some hypotheses, which enable him to establish his fundamental equations. From these he finally deduces the formula:

$$\frac{\mathrm{II}}{\mathrm{P}} = v\,(1+2\,\mathrm{M}\varepsilon)$$

where II represents the loss of heat in the incrusted boiler due to the causes mentioned, P the loss in the non-incrusted boiler, ε the thickness of the calcareous crust, and

$$\mathrm{M} = \frac{\frac{\mathrm{K}}{\mathrm{K}'}\left(1-\frac{b}{\mathrm{A}}\right)}{e+\frac{\mathrm{K}\,\eta}{\gamma}}$$

in which K is the coefficient of conductivity of the boiler plates, K′ of the calcareous crust; b the temperature of the water in the boilers; A the mean temperature of the heated surface of the non-incrusted boiler; e the thickness of the boiler plates; η the thickness of the coating of rust, and γ its co-efficient of conductivity.

By the aid of these formulæ, the loss of heat occasioned by incrustation in steam boilers covered with deposits not exceeding two-tenths of an inch in thickness, is calculated to amount to 40 or 50 per cent.

That a considerable loss must be produced by boiler incrustation is

thus proved, but it seems to be somewhat exaggerated. One result of these calculations seems, however, to be well established, namely, that the consumption of fuel increases rapidly with every increase in the thickness of incrustation.

M. Cousté makes highly interesting remarks on the nature and formation of the deposits. He distinguishes the deposits of marine boilers from those fed with fresh water. The former consist chiefly of sulphate of lime, and contain not a trace of carbonate of lime, while the latter are formed both of sulphate and carbonate in proportions varying with the localities.

He also distinguishes deposits which are merely muddy, or formed of matters suspended but not dissolved in the water, and which are formed of magnesia, oxide of iron, silica, &c., from the crystalline deposits which commence to form when, during the progress of evaporation, the water has arrived at a state of saturation with respect to the salts forming the deposits.

An important fact resulting from M. Cousté's observations is, that the state of saturation is brought about the sooner the water attains a high temperature; that is to say, that the solubility of the sulphate and carbonate of lime diminishes in a rapid proportion as soon as the temperature rises above the boiling point. Between this and the freezing point, the former of these salts has for temperature of maximum solubility 95° F., and at 212° its solubility is not much greater than at 32°. Hitherto the law of its solubility beyond the boiling point has not been examined; and M. Cousté is perhaps the first person who has shown that at temperatures somewhere about 320°, which corresponds to a steam pressure of four or five atmospheres, the solubility is almost destroyed. Upon this fact is founded the principal method proposed by M. Cousté for remedying the formation of incrustations.

He also explains by this circumstance the difficulties which have hitherto interfered with the use of high pressure engines on board seagoing vessels.—*Journal of Industrial Progress.*

For the Journal of the Franklin Institute.

Stand Pipe of the West Philadelphia Water Works. Reply of H. Howson *to* Birkinbine & Trotter.

As a communication on the above subject from Birkinbine & Trotter, which appears in your *Journal* for March, charges me with deliberate falsehood, a sense of justice towards myself suggests the propriety of an immediate and decided answer. The structure itself is not of so meritorious or formidable a character as to deserve more than a passing notice, and a discussion as to the originality of the design cannot afford much general interest to your readers. I shall, therefore, give my reply in as brief and concise terms as the nature of B. & T.'s communication will allow.

In the first paragraph, they state "that I was employed by them as draftsman for a short time while the stand pipe was in progress of erection, and that the design was made before I was so employed." My answer to this is, that I never was employed by B. & T. as their draftsman, ex-

clusively. I made designs and drawings for them, charging by the hour, at the same time drawing for two other machinists, and attending to my duties as a Patent Agent. I furnished B. & T. with drawings and designs, some executed at my own rooms, some on their own premises, not *for a short time during the erection of the works, as they observe*, but some months before they obtained the contract, and for nearly twelve months afterwards. As for the design of the stand pipe, it was, as I have affidavits to prove, made by myself in my own rooms at Kensington, and obtained from me by B. & T. at a moderate cost, on a distinct understanding that it was to be submitted as mine. This, according to my time-book, took place between the 14th and 30th of December, 1852, and I now have in my possession, some of the original sketches of that design.

In reply to paragraph two, I would observe that the lithograph there alluded to, was made from the above design, the names of B. & T. appearing at the bottom, not as designers of the stand pipe, but as engineers of the water works. The statue of Washington mentioned, was made from a sketch of my own, now in my possession.

As to paragraph three, I beg to state that in no *public print* did Messrs. B. & T. ever make a direct claim to the design of the structure, (not even in the *Gleason's Pictorial* alluded to,) until Nov. 18th, 1854. In the *Scientific American* of that date, it is remarked by the editors that they had received a communication from B. & T., stating that they, and not I, were the designers; the editor concluding with his belief as to the justice of my claim.

A claim, however, was made in public *for* B. & T., by a Mr. Browne, at the laying of the corner stone, in a speech, which gave all the credit of the design to B. & T., and alluded to me as the artist who made all the drawings. From that time, seeing a disposition on the part of B. & T. to deprive me of any credit due, I began quietly to procure affidavits substantiating my claim.

In regard to the large drawing alluded to in paragraph four, all I have to say is, that it was made for B. & T., and had on it at the left hand corner, my name as designer when I last saw it. As to the assertion that I never advanced my claim, if Mr. B. will refresh his memory, he will remember a private conversation on the subject, in which the justice of my claim was not denied, his principal argument being that he *had paid* for the design, and consequently it belonged to him. More than this, I am prepared to show that on several occasions, while I was making the working drawings, Mr. B. himself gave me all the credit, and it was not until my assistance could be dispensed with, that he attempted to deprive me of the same.

Paragraph four concludes with the following remarkable assertion: "Nor were we aware of his having made any claims until we saw the article in the *Engineers and Architect's Journal.*" The utter falsity of this will be apparent from the following. The daily *Ledger*, of Aug. 29th, 1854, contains an account of the stand pipe, giving me full credit for the design. The same paper of Sept. 1st, contains a contradictory paragraph, the authorship of which, by the assistance of the officials at the Ledger office, has been traced to B. & T. The *Scientific American*, of Nov. 4th, 1854, contains an engraving and description,

with my claims fully set forth, and the same paper of Nov. 8th, following, contains the above mentioned remarks by the editors of that paper.

Now, the *Engineers and Architect's Journal* is published in London, and the September number, which contains the article referred to by B. & T., should have arrived in this country about the middle of October; through the loss of the ill-fated *Arctic*, however, the number in question was not received here (at least by the Franklin Institute,) until Dec. 8th, some time after my claim had been urged by myself, and questioned by B. & T. in the above mentioned papers, and yet they have the boldness to assert that they received the first intimation of my claim from this English Journal. So much for these gentlemen's veracity, which the following will not have much tendency to sustain. They say in the *Ledger*, September 1st: " The original design and working drawings of the stand pipe were by Joseph Heindl." In the *Scientific American* they say, that they themselves designed it. Which of these is correct? I say neither.

In paragraph 5, B. & T. imply that I did not make the working drawings of the stand pipe, in support of which assertion they enumerate a series of supposed blunders which they allege I made in the communication above mentioned. Now, there is not a casting about the whole structure of which I did not make the drawings, and sketches of them, with memoranda and dimensions, are now before me; from these was made the large drawing which appeared at the last Exhibition. As to the blunders, let me refer to them *seriatim:*

My answer to No. 1 is, that my sketch calls for a 12 inch pipe, in the base plate, as I asserted. If B. & T. have departed from this, I am not aware of it.

No. 2. My mistake here seems to be that of alluding to all the stone-work as being *cut*, whereas a small portion at the top is covered with iron plates to *represent* cut stone.

No. 3. Contains the *enormous* difference of 4 inches in 20 feet.

No. 4. The working drawing of the stone-work calls for a doorway 8 feet high by 3 feet wide, as I asserted.

No. 5. The stairway *does* terminate in a landing 17 feet across.

No. 6. The spire, including the ball, *is* 9 feet 6 inches high.

No. 7. From the foot to the top of the pipe is 130 feet 3 inches; add to this the height of the spire, 9 feet 6 inches, and we have 139 ft. 9 in., just 3 ins. short of 140 feet. This, I contend, is the correct dimension.

No. 8. The landing *is* 114 feet 8 inches, as given; not 115 ft., as B. & T. insist.

So much for my supposed blunders. How is it, I would ask, that B. & T. say nothing about the accuracy of the numerous other dimensions I gave in the Journal? How is it they did not find fault with the dimensions given in the *Scientific American*, of Nov. 4th?

Even suppose the dimensions given by B. & T. to be the correct ones, I would ask the most sceptical observer if, on reading their remarks upon the same, he would not conclude that I must have been very familiar with the structure to have approximated so closely to their measurements, and that the argument of B. & T. is most weak and inconclusive.

Another paragraph in B. & T's. letter, states that the valve gearing was " adopted from drawings procured from England." I presume they

refer to the treatise on the Cornish Engine, by Pole & Wickstead. I have now before me the plates of these works, as well as a drawing of my own arrangement of valve gearing. That the same principle is involved in them all, is without doubt, otherwise they would cease to be the valve gearing of Cornish engines. My arrangement, however, is very different from that in the illustrations mentioned; so different that it was upwards of two weeks after the design was made that Mr. B. could be brought to understand it thoroughly. As a proof of the novelty of my arrangement, I am prepared to furnish you with drawings and descriptions of the same for publication.

In answer to the paragraph relating to the engines now being erected, I would say that I was introduced to Mr. B. as one familiar with the details of pumping machinery; at this introduction, he told me that he knew nothing about Cornish engines. According to agreement, I prepared him a series of plans which were submitted to Mr. Graeff, before the contract for the works of West Philadelphia was given out. Subsequently, and about the date above mentioned, I furnished him with the design for stand pipe. When B. & T. obtained the contract, I made the working drawings for that building; when these were completed, I made a modified design for Cornish engines with new arrangement of valve gearing of which also I made the working drawings.

In a postscript, B. & T. refer to my affidavits. They are from gentlemen who *do* know the truth of all my statements, and whose integrity no aspersions or sneers of theirs can effect.

In your own remarks, as editor, you state that the affidavits show that I was merely employed by B. & T., with other draftsmen.

The question as to employment is already answered. I would ask who the other draftsmen were? The only parties I ever saw about B. & T's. premises who could come under that denomination, were an apprentice of my own, about 17 years of age, and another youth of about the same age, related to Mr. B., and who, it gives me great pleasure to say, was a successful pupil of my own.

The engineering public are apt to decide upon the merits of such a case as the one under discussion, not by assertions and affidavits of either party, but are rather guided in their decision by the known competency or incompetency of the parties to execute the designs in dispute. Knowing this, I would refer your readers to B. & T's. machinery at the Easton and Germantown Water works, and would ask if men who had been in the habit of constructing such machinery, could possibly engage in the construction of large Cornish engines and ornamental towers, without assistance.

I will conclude by making the following proposition to B. & T.: I am prepared to submit the matter in dispute to the decision of three arbitrators, appointed in the usual manner, with the understanding, that the witnesses on both sides be examined under oath, and cross-examination be allowed. Whatever the decision may be, I pledge myself to abide by it.

I am, yours, very respectfully,

H. Howson.

Camden, N. J., March 24th, 1855.

Translated for the Journal of the Franklin Institute.

Notes on the Differences of Temperature between the Air, the Ground under Snow, and the Ground from which the Snow has been removed. By M. Rozet.

Having occasion to know, for a work which I shall soon have the honor of presenting to the Academy, entitled, "On the Rain in Europe;" the differences which exist between the temperatures of the air, the ground under snow, and the uncovered ground, I profited by the coating of snow which covered Paris from the 20th to the 31st of January.

The following table presents the results of my observations made between noon at 4 o'clock P. M., with three thermometers, one placed under the snow, the other uncovered and placed in a little trough in a space from which the snow had been removed, and the third in the free air:

Temperature of air.	Temperature of ground under snow.	Differences.	Temperatures of ground uncovered.	Differences.
—1°·0	0°·0	—1°·0	0°·0	—1° 0
—2°·0	—0°·5	—1°·5	—1°·5	—0°·5
—3°·0	—0°·5	—2°·5	—1°·5	—1°·5
—4°·0	—1°·0	—3°·0	—2°·0	—2°·0
—4°·5	—1°·5	—3°·0	—2°·5	—2°·0
—6°·0	—1°·5	—4°·5	—2°·5	—3°·5
—6°·5	—2°·0	—4°·5	—3°·0	—3°·5

This table shows that the snow really does protect the soil from a noticeable quantity of cold, since from —1° to —6·°5 in the air, the thermometer under the snow varied only from 0° to —2, and the dif-differences increase from —1° to —4·°5.

The thermometer placed in the trough resting on the soil and uncovered, gave me constantly but one degree of cold more than that under the snow, and consequently differences from that in the air varying from 1° to 3·°5.

When I placed a single sheet of white paper on the thermometer in the trough, I got exactly the same numbers as those given by the thermometer covered with 0·05 inch of snow. It follows that the snow acts only as a screen interposed between the soil and free space, which leads us to believe that the results must be independent of the thickness of the coating which covers the earth. When the earth is uncovered over a small space, the contact of the air and radiation takes from it but 1° of heat. The second column of the table, which gives the increase of cold under the snow in proportion as it increases above, proves that snow possesses considerable conducting and radiating powers.

I give these results to attract the attention of meteorologists to a phenomena which appears to me to have a certain importance.—*Acad. des Sciences, Paris, Feb. 5th,* 1855.

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Remarks.—The observations of M. Rozet are undoubtedly important, but we cannot see how they show that the results are not affected by the

thickness of the snow covering. On the contrary, if the conducting and radiating powers of snow be considerable, the greater the thickness, up to certain limits, the less will the earth cool. And our experience in severe winters shows that when the earth is deeply covered with snow, the severest cold of the air scarcely affects its surface, while under a coating of but a few inches, the crust is frequently frozen to some depth. F.

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*Lifting Brick Buildings by Hydraulic Pressure.**

A letter from San Francisco, in the *North American*, says,—They are now grading the streets of the city, filling in some and cutting down others. When the former process is being done, it becomes necessary to raise the houses. You have heard of moving houses entire, but here we lift them up by hydraulic pressure. Whole piles of brick buildings are being raised in this mode where the streets have been filled up, and thus the lower floors are brought up to the new level of the streets. Last week, a warehouse belonging to Alsop and Co., 50 feet front and 70 feet deep, having three stories and a basement, a heavy brick building, was raised 5 feet, and then under-built with stone, all without moving out, or even disturbing the clerks with their pens at the desks! Another store, not quite so large, but having in it 2000 tons of hardware, was raised in six days, and a new story added to it at the bottom.

For the Journal of the Franklin Institute.

Performance of the Cornish Pumping Engines of the Buffalo Water Works.

By Henry Cartwright, Supt. Eng., in construction of the Works.

In preparing for publication in the "*Journal*" a tabular monthly statement of the performance of the two pumping engines of the Buffalo Water-Works, the motive has been, to promote in the United States, a system of recording facts, from every-day operations, of the various branches of the mechanic arts, and to give to them, that publicity, which every one must admit to be, the best means of causing emulation, and consequently bringing them nearer to perfection.

After an examination, into the various plans employed in raising water by steam power, in this country and in Europe, and feeling convinced of the great superiority, and working economy of the Cornish Engine, it was decided upon by the contractors for these works, the late firm of Battin, Dungan & Co. of this city, that they would be the "pioneers," and accordingly settled upon the adoption of the Cornish pumping engines, the first to be constructed in the United States, for supplying a city with water. Since their completion, in December 1851, several other cities, that have been, or are being supplied with water, required to be elevated by steam power, have adopted this class of pumping machinery, and doubtless the demonstrated economy of their performance, will recommend them, over any and all others, in which steam is employed.

The plan of these engines, is known among Cornish engineers, as the "Bull Engine"—the cylinders being inverted over the pumps, and the

*From the Lond. Builder, Nov. 1854.

piston-rod connecting directly to the plungers of the same; thus economizing very considerably in the first cost of the engine and space occupied, as also admitting of a most secure and permanent plan of binding together from the foundation upward, without being subjected to any lateral strain, having a tendency to move the machinery "out of line."—

By a comparison of the following tabular statement, with the reported "duties" of the pumping engines of Cornwall, it will be observed there is still room for improvement; which advantage in the mining engines is readily accounted for, in the incessant working and the great mass of matter put in motion, or momentum acquired, which give an opportunity of using steam of a high pressure (40 a 60 lbs.) and expanding through a very large proportion ($\frac{9}{12}$ a $\frac{11}{12}$) of the stroke—whilst in these engines the load is so light as to preclude the benefits of such high expansive action of the steam, and which are worked with an average of 10 lbs., and a vacuum of $27\frac{1}{2}$ inches and cutting off at half stroke.

The following are the dimensions of the two engines, boilers, and single acting plunger pumps:—

Diameter of Cylinders 50 inches—Stroke 10 feet.
" " Pumps, 24 " " "
4 Boilers—Cylindrical, with internal Firing-flue.
Length of Boilers, 30 feet.
Diameter " " 5 " 6 inches.
" Firing-flue 3 " 6 "
Engine Load, at each stroke lifting 22,012 lbs.

In the statement, there are two colums of "duties," one of which, shows the actual work that the steam performs, and is obtained by the formula adopted by the Cornish engineers—as follows:—

$$\frac{\text{Engine load} \times \text{number of strokes}}{\text{Quantity of coal consumed,}} \times 100 = \text{Duty.}$$

the other showing the quantity of water elevated—as follows:—

$$\frac{\text{Content of pump in lbs.} \times \text{number of strokes} \times \text{by height raised}}{\text{Quantity of coal consumed,}} \times 100 = \text{Duty.}$$

Instead of taking the bushel of coal of 94 lbs, as the unit of duty, as taken in Cornwall, these calculations are based upon the unit of 100 lbs. coal, and which appears to be a more satisfactory basis; as the specific gravity of different coals produces a result in the same ratio.

The fuel used at Buffalo during the time shown in the statement, has been, bituminous coal from Erie, Pa. anthracite coal from the Lackawanna region, near Scranton, Pa. and beach, maple, ash, and some oak wood Wood is now exclusively used and found to be the cheapest, at the advanced price of coals.

It may be proper to add, in reference to the running expenses of the engines or cost of pumping, that it can be shown, these works have produced a more economical result in dollars and cents, than in any other steam works, that have come under our observation—whilst the items, of "repairs of machinery" have been nearly nominal, not exceeding \$ 25, since the machinery was accepted from the builders, Messrs. I. P. Morris & Co., of this city, in February, 1852, and for their skill and reputation in the execution and permanence of the work, no more flattering testimonial than this need be offered.

Statement of the performance of the Engines of the Buffalo Water Works.

	Pumping Days.	Number of Strokes.	Pumping time. H.	Pumping time. M.	Strokes per minute.	lbs. coal raising steam.	lbs. coal pumping time.	Total coal consumed.	Gallons raised to reservoir.	lbs. coal per hour pumping.	Gallons raised per lb. coal in pumping.	lbs. water raised one foot high with 100 lbs. coal.	Engine duty.
1852. July,	9	34,554	93	30	6·1+	9,546	16,289	25,835	7,947,320	174	488	33,304,550	46,700,000
" August,	9	29,600	77	06	6·4—	8,737	10,921	19,658*	6,808,000	142	623	42,528,800	60,000,000
" September,	10	37,378	92	00	6·8—	11,467	12,959	24,426*	8,596,940	141	663	45,283,940	63,290,000
" October,	9	32,945	77	47	7· +	11,277	10,298	21,575*	7,577,350	132	736	50,226,900	70,406,000
" November,	18	66,865	145	30	7·6+	19,676	19,844	39,520*	15,378,950	136	775	52,821,030	74,174,000
" December,	10	40,242	86	55	7·7+	11,845	13,479	25,324*	9,255,660	155	687	46,872,870	65,615,000
1853. January,	10	51,216	125	25	6·8+	11,762	17,541	29,303*	11,779,680	140	672	45,840,670	64,421,000
" February,	10	53,860	128	00	7· +	11,919	19,595	31,514*	12,387,800	153	637	43,154,000	60,500,000
" March,	10	52,782	117	35	7·5+	11,714	19,196	30,910*	12,139,860	163	632	43,173,440	60,512,000
" April,	10	53,096	117	20	7·5+	8,730	23,710	32,440	12,212,080	202	515	35,158,500	49,315,000
" May,	10	47,385	104	10	7·6—	7,140	22,685	29,825	10,898,550	218	480	32,800,000	46,000,000
" June,	25	74,871	158	40	7 87	14,275	35,945	40,220	17,229,330	226	479	32,702,000	46,000,000
" July,	24	78,833	166	50	7·87	14,725	35,910	40,635	18,131,590	215	505	34,466,110	48,336,000
" August,	20	103,523	222	00	7·8—	12,700	56,290	68,990	23,810,290	254	423	28,873,880	40,475,000
" September,	20	72,678	154	35	7·8+	13,100	39,700	52,800	16,715,940	257	421	28,760,000	40,300,000
" October,	18	75,417	165	48	7·6—	12,200	39,953	52,153	17,345,910	239	434	29,636,000	41,500,000
" November,	23	101,318	233	40	7·2+	16,100	52,750	68,850	23,303,140	226	443	30,155,300	42,240,000
" December,	18	74,517	167	30	7·4+	13,500	42,400	55,900	17,138,910	253	404	27,592,380	38,450,000
1854. January,	24	99,118	229	06	7·2+	18,600	57,900	76,500	22,797,140	253	394	26,876,560	37,855,000
" February,	23	125,161	294	25	7· +	17,100	66,600	83,700	28,787,030	226	432	29,504,920	41,367,000
" March,	27	142,355	322	23	7·3+	20,500	66,700	87,200	32,741,650	207	491	33,507,850	47,000,000
" April,	22	98,439	236	45	6·2+	16,500	51,700	68,200	22,640,970	218	438	30,000,000	41,912,000
" May,	26	121,548	287	50	7· +	17,600	54,700	72,300	27,956,040	190	511	34,923,000	49,000,000
" June,	25	131,501	314	30	7· —	17,800	65,300	83,100	30,245,230	208	463	31,633,000	44,328,000
" July,	23	119,734	265	35	7·5+	15,800	61,300	77,100	27,538,820	230	449	30,681,000	43,000,000
" August,	23	117,966	261	00	7·5+	16,200	60,000	76,200	27,132,180	230	452	30,900,000	43,566,000
" September,	22	108,234	239	25	7·5+	15,400	54,100	69,500	24,893,820	226	460	31,430,000	44,040,000
" October,	17	81,558	176	00	7·76	11,700	41,300	53,000	18,758,340	235	454	31,020,000	43,470,000
" "	4	19,618	41	15		9$\frac{1}{8}$ cords			4,512,140				
" November,	22	104,655	227	20	7·7—	65 "	beach, maple,		24,070,650				
" December,	26	140,010	311	25	7·5+	81$\frac{1}{2}$ "	oak, and ash		32,202,300				
1855. January,	26	135,846	309	05	7·3+	80$\frac{5}{8}$ "	wood.		31,244,580				
" February,	23	154,071	348	30	7·4—	88$\frac{3}{4}$ "			35,436,330				

* Lackawanna anthracite, from Scranton, Pennsylvania.

In conclusion, I hope that the foregoing may call out other "expositions" that will show to the world, what is "doing in mechanics."

Philadelphia, March 17, 1855.

For the Journal of the Franklin Institute.

Particulars of the Steamer Ocean Bird.

Hull built by J. W. Griffith, New York. Machinery, by Neptune Iron Works, New York. Intended service—For Sale.

Hull.—

Length on deck from fore part of stem to after part of stern post above spar deck,		225 feet.	
Breadth of beam at midship section, above the main wales,		37 "	
Depth of hold,		16 "	
" " to spar deck,		23 "	
Draft of water at load line,		8 "	6 inches.
" " below pressure and revolutions,		8 "	3 "
Area of immersed midship section at this draft,		272 sq. "	
Masts and rig—	Brigantine.		

Engine—Vertical beam.

Diameter of cylinder,			65 inches.
Length of stroke,		12 feet.	
Maximum pressure of steam in pounds,	25.		
" revolutions per minute,	19.		

Boilers—Four—Return flued.

Length of boilers,	2 of 20 and 2 of 22 feet.		
Breadth "		9 "	6 inches.
Height " exclusive of steam chimney,		10 "	2 "
Number of furnaces in each,	2.		
Length of grate bars,		6 feet,	6 inches.
Number of flues,	1st tier, 10,	2nd tier, 5.	
Internal diameter of flues,	" 12, 13, 18,	" 19.	
Length of flues,	" 9 ft. 4 ins.,	" 15 feet, 8 ins.	
" "	" 14 ft. 1 in.,	" 17 " 8 "	
Heating surface,		4475·44 sq. feet.	
Diameter of smoke pipes,	2 of		
Description of coal,	Bituminous.		

Paddle Wheels.—

Diameter,		33 feet.	
Length of blades,		7 "	9 inches.
Depth "		1 "	10 "
Number "	28.		

Remarks.—Floor Timbers at throat, *molded*, 12 inches;—*sided*, 10 and 12 inches;—distance of frames *apart*, *at centres*, 20, 21, and 24 inches. Hull strapped with diagonal and double laid iron straps 4 by $\frac{5}{8}$-inch; coppered. Engine and boilers are in a water tight compartment.

This vessel is the one generally known as the six-day steamer.

C. H. H.

For the Journal of the Franklin Institute.

Particulars of the Steamboat Commonwealth.

Hull built by Laurence & Finches, New York; machinery, by Morgan Iron Works, New York; intended service, New York to Norwich.

Hull.—			
Length on deck, from fore part of stem to after part of stern post above the spar deck,		316 feet.	
Depth of hold,		13 "	3 inches.
Draft of water at load line,		8 "	
" " below pressure and revolutions,		7 "	6 inches.
Tonnage, custom house,	1600.		
Contents of bunkers in tons of coal,	30.		
Engine—One—Vertical Beam.—			
Diameter of cylinder,			76 inches.
Length of stroke,		12 feet.	
Maximum pressure of steam in pounds,	40.		
Cut off at half stroke,			
Maximum revolutions per minute,	19.		
Boilers—Two—Return flued.—			
Length of boilers,		38 feet.	
Breadth "		13 "	6 inches.
Diameter of shell,		11 "	
Height " exclusive of steam chimney,		12 "	6 "
Number of furnaces,	6.		
Breadth of furnaces,		4 feet	2 inches.
Length of grate bars,		8 "	
Number of flues.	10 main and 6 return.		
Internal diameter of flues,		18, 16, and 13 inches.	
Heating surface, (fire and flues,)	5000 sq. feet.		
Diameter of smoke pipes,			56 inches.
Height " "		40 feet.	
Description of coal,	anthracite.		
Draft,	blowers.		
Paddle Wheels.—			
Diameter,		38 feet.	
Length of blades,		10 "	6 inches.
Depth,			32 "
Number,	28.		

Remarks.—Floor timbers at throat, *molded* 19 in.; *sided*, $6\frac{1}{2}$ in.; distance of frames apart *at centres*, 24 ins. Frame strapped with diagonal double laid iron straps 4 by $\frac{5}{8}$-inchs.

C. H. H.

Process for Tinning Metals. By MM. Roseleur and Boucher.*

The authors tin metals by decomposing solutions of certain double salts of tin, especially the phosphate, pyrophosphate, borate and sulphite, by means of the galvanic current. A solution for this purpose is obtained by dissolving 3 kilogrms. of pyrophosphate of potash, and 508 grms. of protochloride of tin, in 200 litres of water. The temperature is raised to about 186° F.; and the bath may be kept saturated with tin by means

* From the London Chemical Gazette, No. 296.

of anodes of tin, by the action of the galvanic current. If it be observed that the bath does not deposit sufficient metal, a certain quantity of chloride of tin may be added to it; this at first forms a white precipitate, which however is again dissolved. A bath of this description, which had been constantly employed for a fortnight in tinning, required no addition of pyrophosphate, so that it might be expected that nothing of the kind would be necessary even for a much longer time. This process appears to be the only one proper for protecting zinc employed in roofing, in sugar moulds, and kitchen utensils, from oxidation.

Cast iron tinned in this manner exhibits a fine silver-like appearance. The fluid for this purpose is prepared with—

Distilled water or rain water, .	500 litres.
Pyrophosphate of soda, . .	6 kilogrms.
Commercial tin-salt, . .	1 "
Dried and fused tin-salt, . .	1½ "

According to the strength of the alkaline reaction of the pyrophosphate of soda, which is not always of the same composition, the quantities of the fused and acid tin-salt must be varied. The bath must be kept at a temperature of 168°–186° F. The authors consider this composition to be the best, as its slight alkalinity precludes the disadvantage attending the use of an acid bath, which is favorable to oxidation, whilst it does not, like the strongly alkaline baths, deposit the tin of a bluish color, nor require much washing to get rid of its taste.

At first the authors employed a separate galvanic battery, but it appears that this is only necessary in coating zinc with tin. For other metals it is sufficient to immerse these, previously well cleaned, in the bath, together with some pieces of zinc, when they will be covered with a dull coating of tin in the course of two or three hours. This may be polished with a wire-brush. If the coating of tin is required to be thick, the objects must be immersed several times. The bath may be used almost constantly; it is sufficient, before introducing new objects, to add 300 grms. of pyrophosphate of soda and the same quantity of the tin-salt. The pieces of zinc are gradually dissolved.

The bath employed in tinning zinc has the following composition:—

Distilled water or rain water, .	600 litres.
Pyrophosphate of soda, . .	5 kilogrms.
Dried and fused tin-salt, . .	1 "

Le Technologiste, 1854, p. 629.

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*Curiosities in Science.**

During a lecture, by Professor Faraday, at the Royal Institute, a piece of pure iron, peculiarly prepared so that its particles might present a large surface to the action of the oxygen in the atmosphere, was ignited, and continued to burn like tinder. The ready combustion of iron compared with gunpowder was shown by a very simple experiment. Some iron filings and gunpowder were mixed together, and sprinkled into the flame of spirits of wine burning on a plate, when the iron filings caught

* From the London Mining Journal, No. 995.

fire and burnt in bright sparks, whilst the gunpowder passed through the flame without igniting; and the quantity that fell on the plate was afterwards dried and exploded. Lead prepared in a similar way was shown to be still more inflammable, for it caught fire in a beautiful flame when exposed to the air. Professor Faraday stated that lead is nearly as inflammable as phosphorus, and he explained the cause of its not burning in ordinary circumstances, to be that the solid product of combustion forms a film that prevents contact with the oxygen, and the conducting power of the other parts of the metal draws off and dissipates the heat. He pointed out the admirable arrangements by which these combustible properties of the metals are kept in proper control, and bodies that are really so inflammable are made to serve as strong resisters of combustion. Professor Faraday next explained the distinction between combustion and explosion, which consists simply in the different rapidity of the two actions, for during the former process the combustible and the supporter of combustion are brought together by degrees, as in the flame of a candle, but in explosions they are both intimately mingled together, and can be brought into action at once. A mixture of hydrogen and oxygen gases, in the proportions in which they are combined in water, was adduced as an example, and a soap bubble blown with those gases was exploded, as an illustration. The cause of the explosion of gunpowder and of other substances that explode without access of air was shown to be owing to the large quantities of oxygen in a solid state that enter into the composition of such explosives, and being intimately mixed with the combustible, afford an instantaneous supply of the supporter of combustion, which enables them in some instances to burn under water. This was illustrated by several striking experiments, including the burning of a marine fuse. Professor Faraday said, that though animal heat is not, generally speaking, caused by combustion, yet the analogy between the processes is so close, that he could not with satisfaction to himself conclude his lectures on the chemistry of combustion without alluding to the subject, and showing the nature of the changes that are going on in the lungs during respiration. He then arranged some experiments to prove the absorption of carbonic acid in the lungs, and he presented on a plate, a mass of charcoal weighing 7 lbs., as representing the quantity that passes from the lungs of a man during every 24 hours. The volume of carbon in the atmosphere, though it contains only one per cent. of carbonic acid, is, he stated, greater than all the carbon that is stored in coal strata in the earth, or spread on the surface of the globe in vegetation.

On the Manufacture and Application of various Products obtained from Coal (Coal-gas excepted.) By Prof. F. Crace Calvert, F. C. S., &c.*

Mr. Crace Calvert commenced his paper by stating that there were two distinct theories by which the formation of coals was explained; and in consequence of the geological influences to which they had been submitted, the coals presented great differences in their composition; as,

*From the Journal of the Society of Arts, November, 1854.

for example, some were entirely composed, as anthracite, of nearly pure carbon, whilst others contained but a small proportion of fixed carbon, and a large proportion of tarry substances or hydro-carbons; such, for example, as cannel, bog-head, and Albert coal, from New Brunswick; and this lead Mr. Crace Calvert to divide coal into three distinct classes, having regard to the distinct applications which they received in manufactures: the first class being employed as fuel in generating steam; the second for making coke; and the third kind chiefly for producing gas. The most valuable researches which had been published upon the composition of coals, and the relative value of different kinds, principally for generating steam, were published in a voluminous report of experimental investigations on coal for the steam navy, by Sir H. De la Beche and Dr. Lyon Playfair, and presented to the House of Commons, by Royal command. The results of those investigations exemplified that most valuable information might be obtained from scientific researches on the relative value of different kinds of this important fuel for generating steam in manufactories, the steam-navy, &c. In fact, the English navy had already derived great advantages from the elaborate researches of the scientific gentlemen before-mentioned, to whom, no doubt, was due the credit of anthracite coal being now extensively used by our large steamers in their voyages to the Cape and Australia. That great improvements were yet to be made in the construction of the apparatus for generating steam, and of economy in the use of particular kinds of fuel, was evident from the fact (mentioned in the report before alluded to) that the combustion of one pound weight of coal in the best constructed boilers of the present day, converted into steam only 10 lbs. of water at a temperature of 212°, instead of $14\frac{1}{2}$ lbs., which was the quantity demonstrated to be practical of realization.

The following Table is an abstract of the researches contained in the report above-mentioned:—

Actual and Theoretical Duty of Coals.

	Practical. lbs. of Water converted into Steam at 212° by one lb. of Coal.	*Theoretical.* lbs. of Water at 212° converted into Steam-coke left.	*Theoretical.* Total lbs. of Water converted into Steam by one lb. of Coal.
Graigola,	9·35	11·31	13·563
Anthracite,	9·46	12·554	14·593
Pentrefelin,	6·39	10·841	13·787
Powel's Duffryn,	10·15	11·134	15·092
Three-qr. Rock vein,	8·84	7·081	13·106
Pontypool,	7·47	8·144	14·295
Ebbw Vale,	10·21	10·441	15·635
Dalkeith Jewel Seam,	7·08	6·239	12·313
Fordel Splint,	7·56	6·56	13 817
Broomhill,	7·30	7·711	14·863
Slievardagh (Irish,)	9·85	10·895	12·482

Another fact ascertained by the researches and experiments of the

same gentlemen, was, that certain kinds of coal were superior for generating steam rapidly, by their quick combustion; while other kinds were better employed for steaming on long voyages, from their slow combustion.

The ordinary kind of coal was, generally speaking, divided into two classes; the best quality being employed for household use, while the inferior was used for generating steam. Great economy had resulted of late years in the use of household coal, owing to the extensive use of coke in manufactures; this class of coal being sifted at the pit's mouth, the small and less valuable part was used for making coke, while the lumps and larger pieces were employed as household fuel.

It was necessary to say a few words on the manufacture of coke. The best coals for making coke were those which would yield from 60 to 75 per cent. of coke, with but a slight trace of sulphur, and which had the property of caking or melting together, so as to form a solid mass in the oven. This superior quality of coal was found near Newcastle-upon-Tyne, and in Lancashire; the best coke being made from what is called "Mountain Mine." These superior cokes were characterized by their high density, the brilliancy of their appearance, and their superior power of generating steam. He had noticed, from long observation of the manufacture of coke, that the best kind was made when three or four feet in depth of coal were introduced into moderately large ovens; allowed to cake for 60 to 90 hours, and cool for 24 hours previously to being drawn.

He had succeeded of late years in discovering a simple process for removing sulphur from coke, thereby greatly enhancing its value for melting cast iron in the cupola, and increasing the bearing strength of the metal. This was proved by the results obtained by Mr. William Fairbairn, and Messrs. Fox & Henderson. The application of the same process to blast furnaces had enabled Mr. Crace Calvert materially to improve the quality of the iron obtained. Mr. Crace Calvert next drew attention to the third class of coals, namely, those employed principally for making gas. These coals, viz., cannel and bog-head, although for commercial reasons Newcastle and other coals of that character are used, were remarkable for yielding in addition to about 30 per cent. of an inferior coke, a large quantity of gas, and numerous other products of greater or less value. The accompanying table would give an idea of the numerous products which chemists had ascertained to exist in the substances distilled from coal:—

Gases.	*Liquids.*	*Solids.*
Bicarburetted hydrogen,	Bisulphuret of carbon,	Naphthaline,
Propyline,	Ammonia,	Para naphthaline,
Light carburetted hydrogen,	Eupion,	Paraffine,
Hydrogen,	Paraffine oil,	Pyrene,
Oxide of carbon,	Aniline,	Chrysene.
Sulphuretted hydrogen.	Leukol,	
	Carbolic acid,	
	Benzine,	
	Napthine,	
	Napthole.	

It will be perceived from this table that the products obtained from

coals were divisible into three classes, namely, gases, liquids, and solids. He did not intend to dwell upon the first class—the gases—which subject was so extensive that it would require to be treated in a separate paper. With respect to the solid products of coal, he would first allude to the coke which was obtained in making gas.

The coke generally obtained from gas-works was very inferior. Great efforts had lately been made to obtain the various products of coal, and also to manufacture good coke for cupola and railway purposes, at the works of the London Gas Company, but he was not aware of the exact results obtained.

The liquid products from coal could be divided into two distinct classes, the aqueous portion and the tarry portion. The aqueous portion was valuable chiefly for the ammonia which it contained, and which was put to the following amongst other uses: In the first place, it was bought by chemical manufacturers, who obtained from it sulphate of ammonia for agricultural purposes, sal ammonia for soldering, and which was also used in calico and print works in the production of a style of prints called "steam goods." From these two salts was obtained hartshorn, which was extensively employed in pharmacy.

Ordinary coal gas liquors was often employed to obtain by distillation common ammonia, which was much used in dye works; also to produce, with lichens, beautiful coloring matters called orchill and cudbear, valuable for the production on silk and wool of delicate purple hues. The production of this color and the influence of ammonia was exceedingly interesting, on the ground that the coloring principle called orcine was colorless until acted upon by the oxygen of the air and ammonia. If to this ammonia a fixed alkali be added, then no more orchill or cudbear was produced, but litmus, which was now much used in chemistry as a test for acids and alkalies.

One of the most interesting and useful of the applications of ammoniacal liquors was in the preparation of ammoniacal alum. The manufacture of this substance had become very extensive of late years. At the chemical works of Messrs. Spence & Dixson, near Manchester, 800,000 gals. of ammoniacal liquor were annually consumed in the manufacture of ammoniacal alum, the ammoniacal liquor being obtained from the extensive gas-works belonging to the corporation of Manchester. The manufacture of this substance, which was so valuable as an astringent, and also to the dyer and calico printer, furnished such a remarkable illustration of the value of chemistry in aiding manufactures and commerce, that he would explain briefly the method of producing it. To obtain this substance called ammoniacal alum, a refuse product of coal pits, known as aluminous shale, was heaped into small mounds and slowly burned. Shale was generally found in hard masses, which fell from the roofs of the coal mines, and the object of burning it was to render it porous and friable. The calcined friable mass was then placed in large leaden vessels, with sulphuric acid, having a specific gravity of 1·65, being the strength in which it was obtained from the leaden chambers. It was a curious fact that this sulphuric acid could be produced from another refuse found in coal mines, namely, pyrites.

The calcined shale and sulphuric acid were heated in these leaden

chambers for about forty-eight hours, the liquor was then drawn off and put into another vessel, into which the ammonia generated from another refuse of coal, namely, the gas liquor, was introduced in a gaseous state. Thus these three substances, the alumina from the shale, the sulphuric acid obtained from the pyrites, and the ammonia from the gas liquor, combined to produce ammoniacal alum, which then only required purifying by successive processes of crystallization to give it that remarkable purity in which it was furnished to the commercial world by Messrs. Spence & Dixson, and other manufacturers.

A great boon would be conferred upon agriculturists if the ammonia which was produced when coke was made in common ovens, were saved, as recommended by Dr. Lyon Playfair, who estimated that every hundred tons of coal would yield, on the average, about six tons of sulphate of ammonia. The quantity of coke made annually in England amounted to at least 1,000,000 tons, yielding, therefore 60,000 tons of sulphate of ammonia, which might be made a cheap and valuable agent in agriculture. When the minimum advantages which manufactures had derived from saving the ammoniacal products in gas-works were remembered, it ought to encourage coke manufacturers and engineers to exert themselves to effect the same. In so doing they would confer a great benefit on the public, as coke would thus be enabled to be sold at a lower price. It was interesting to reflect that, no doubt, at the present day, tons of salts of ammonia were made, where formerly pounds were imported into England, from a district called Ammonia, in Nubia, in Egypt, and which, in the form of salammonia, was derived from heating in glass vessels the soot which had been produced by the burning of camels' dung. The same line of thought might also be applied to alum, which formerly came entirely from the East, then from the environs of Rome, and now, through the application of chemistry to manufactures, the progress of human intelligence, the undaunted perseverance of our countrymen, was manufactured in England from what had been hitherto noxious and refuse products.

Mr. Crace Calvert next spoke of tar. This substance was generally sold to the tar distillers, who obtained from it a volatile fluid called coal naphtha, a light oil, composed principally of carbolic acid and a heavy oil of tar, a solid substance called pitch being also left in the retort. Mr. Crace Calvert then proceeded to state the applicatons which these various materials received. Pitch had of late years been used successfully by the corporation of Manchester in assisting to pave the streets. When the streets were repaved, a large quantity of this pitch, to which was added tar and asphalte, was heated in portable boilers in the street, and was poured, when in a hot liquid state, upon small pebbles or gravel between the interstices of the paving stones, which were thus firmly bound together and became so durable that the most frequented thoroughfares in Manchester, when thus paved, had not required repaving for several years. There was, however, this important sanitary advantage connected with the plan, and to which he wished to draw special attention, namely, that no impure matter and stagnant water could percolate through the impervious pavement and collect beneath, giving forth noxious effluvia, to the injury of the health of the inhabitants of large cities, and even

causing dangerous epidemics. The importance of this process would be the more apparent when it was calculated what a vast surface area was presented by the streets of a large city.

This pitch had also of late been submitted by Mr. Bethell to a further distillation in retorts, which enabled him to obtain a porous, but at the same time a dense coke, and the oils which were distilled in this operation appeared to be such as might be employed to advantage as lubricating agents for common and heavy machinery. Before passing to the various volatile products obtained from the distillation of tar, Mr. Crace Calvert stated, that tar had been applied lately, when mixed with gutta percha or india rubber, to insulate telegraph wires, and to prevent metals from being acted upon by the atmosphere.

One of the first products which came over in the distillation of tar, was a mixture of very volatile hydro-carbons, which had received the name of crude naphtha, and this, when again distilled, was sold under the name of naphtha, and was chiefly burned by the keepers of stalls in streets and markets. When naphtha had been mixed with turpentine, it was called camphine, and was burned in lamps in private dwellings.

When it was intended to apply this naphtha to more particular purposes, it was purified by mixing it with ten per cent. of its bulk of concentrated sulphuric acid, and when the mixture was cold, about five per cent. of peroxide of manganese was added, and the upper portion was submitted to distillation. The rectified naphtha found in the receiver, had a specific gravity of 0·85. This rectified naphtha was used to dissolve caoutchouc for making garments impermeable to water, known as Mackintoshes; and when sulphur was added, and the mixture submitted to steam having a temperature of from 400 to 500 degrees, vulcanized india rubber was produced.

Rectified naphtha was also used for mixing with wood naphtha, to render the latter more capable of dissolving resins for the production of cheap varnishes. When this rectified naphtha had been submitted to a series of further purifications, it had received from an eminent French chemist named Pelouze, the name of "benzine," which had the property of removing with great facility spots of grease, wax, tar, and resin, from fabrics and wearing apparel, without injuring the fabric, its color, or leaving any permanent smell or mark, as was the case with turpentine. Benzine had, through his (Mr. Calvert's) exertions, been introduced into England, and had been found most valuable in brightening velvets, satins, &c. The numerous uses to which this valuable product could be applied in manufactures, must in time render it of extensive employment in place of alcohol and other fluids, which were, generally speaking, too expensive for common commercial purposes. As an instance, he cited that at the present day in Yorkshire there was a large quantity of wool dyed before it was spun, principally for carpet manufactures. It was then necessary to oil this dyed slubbing wool, as it is called, and up to the present time no means had been discovered of removing the oil without injuring the color, and thus this oil remaining in the fabric materially injured the brilliancy of the color, as well as rendered the carpets thus manufactured liable to become sooner faded or dirty. Now, by the employment of benzine, which had not the property of dis-

solving colors, the oil could be removed from such fabrics, and the full brilliancy of the colors fixed on this slubbing wool be restored. He also stated that this benzine could be employed with advantage in photography, in removing the grease from daguerreotype plates. When this benzine was treated with strong nitric acid, it gave rise to a substance called nitro-benzine, which was every day becoming more and more employed as a substitute for essence of bitter almonds, was used for flavoring dishes, and communicating scents to perfumery, soaps, &c. It was interesting to observe that thus, by the triumphs of chemistry, a delicious perfume had been produced from the noxious smelling refuse of coal.

The next products he should mention which were distilled from coal, were those which had the name of light oils of tar, which remain on the surface of water, and which had been applied, conjointly with the heavy oils, with great success by Mr. John Bethell, to the preservation of wood from rotting. Wood which had been treated by Mr. Bethell's process, was extensively employed as railway sleepers, and wherever wood work was exposed to the influence of moisture and the atmosphere. The introduction of the fluid into the wood was effected by placing the wood in close iron tanks, exhausting the air, and then forcing the oil into the whole substance of the wood, under a pressure of from 100 to 150 lbs. to the square inch.

There existed in these light oils of tar a product highly interesting, called tar creosote, or carbolic acid, which possessed extraordinary antiseptic properties; such, for example, as preventing the putrefaction of animal subtances. He (Mr. Crace Calvert) had applied it with success in preserving bodies for dissection, and also in preserving the skins of animals when intended to be stuffed. Owing to its peculiar chemical composition, he had also employed it successfully of late in the preparation of a valuable dye-stuff, called carboazotic acid, which gave magnificent straw-colored yellows on silk and woollen fabrics. The carboazotic acid prepared from the above-mentioned substance could be obtained very pure, and at a cheap rate, thus enabling the dyer to obtain beautiful yellows and greens, which were not liable to fade by exposure to the air, as was the case with most of the yellows and greens which were obtained from vegetable dyes. The advantage of the carboazotic acid, so prepared, was, that it was entirely free from oily or tarry substances, which had the property of imparting a disagreeable odor to the dyed fabric. The intense bitter which this acid possesses had induced him to have it tried as a febrifuge, and Dr. Bell, of Manchester, had succeeded in curing several cases of intermittent fever by its aid, in the Manchester Infirmary. He had also placed some of this substance in the hands of eminent physicians throughout the country, and he hoped shortly to ascertain that it was of real value as a substitute for that expensive medicine, sulphate of quinine.

He had lately applied carbolic in a manner that offered advantages to dyers and calico printers. It was well known that extracts made from tanning matters could not be kept for any length of time without undergoing deterioration, in consequence of the tanning matter which they contained becoming decomposed, and transformed, by a process of fer-

mentation, into sugar and gallic acid; which acid, he had ascertained, not only had no dyeing properties, but that, on the contrary, it was injurious, from having a tendency to remove the mordants which were employed to fix the colors on the cloth. It was also known that gallic acid possessed no tanning properties. By adding a small quantity of carbolic acid to the extracts of tanning matter, they could in future be kept and employed by the dyer as a substitute for the substance from which they were obtained—by which would be gained the double advantage of saving labor, and obtaining a better effect from the tanning matters.

The third substance which passed off in the distillation of tar was called heavy oil of tar, which was used by Mr. Bethell as above stated. This substance contained a singular organic product, first discovered by Dr. Hofmann, of London, and called by him "kyanol" or "aniline," which possessed the property of giving, with bleaching powder and other agents, a magnificent blue color. This fact led him (Mr. Calvert) to observe that this last mentioned substance, as well as carboazotic and indigotic acids, being produced as well from indigo as from coal-tar, proved the great similarity and chemical connexion which existed between the products of tar and those of indigo, and induced him to believe it extremely probable that those products would be employed within a few years as substitutes for indigo and madder. Laurent had succeeded in obtaining two products from naphthaline which had a great analogy to the coloring principles of madder. A substance, for instance, called chloronaphthalic acid had the same composition as the coloring matter of madder, and would be identical if the hydrogen gas was substituted for the chlorine which the acid contained. Hence the chloro-naphthalic acid had the property of giving with alkalies a most superior red color.

When the coloring principle of madder was treated with nitric acid, a substance called alizaric acid was obtained, which was identical with a substance also obtained from naphthaline called naphthalic acid. Naphthaline was a solid white substance, which distilled in large quantities during the distillation of tar.

An interesting fact had been discovered by Mr. James Young, of Glasgow, namely, that if coals were distilled at a low temperature, the products obtained were different from those which were produced when coals were distilled at a high temperature, as was the usual custom in the manufacture of gas. Without entering into all the details on this point, he would mention one of the most striking differences of results, namely, that Mr. Young obtained in place of the naphthaline, a valuable lubricating agent, called paraffine, a solid substance, and a large quantity of carburetted hydrogens were also distilled, which, being free from smell, were valuable for commercial purposes, and had received the general name of paraffine oil; or, as Dr. Lyon Playfair remarked in his report of the Great Exhibition of 1851, it was "liquified coal gas." This paraffine oil, when mixed with other oils, was now most extensively employed in the cotton-mills of Manchester and the neighborhood. Solid paraffine was also obtained in the distillation of peat, and was employed for manufacturing candles, there being added to it about 20 per cent. of

wax. These candles were remarkable for their transparency and the pureness of their flame. Mr. Crace Calvert exhibited specimens of these candles, and of the various substances mentioned in his lecture, and by which he had illustrated his remarks throughout, and exemplified the truth of his facts and statements. He stated that he was indebted to Mr. Edward Binny, of Manchester, for the collection of coals which were on the table, and to Mr. Clift for most of the valuable specimens of products obtained from coal-tar.

To be Continued.

For the Journal of the Franklin Institute.

Particulars of the Steamer Ariel.

New York.—Hull built by J. Simonson, New York. Machinery by Allaire Works. Owner, C. Vanderbilt. Intended service, New York to Liverpool.

Hull.—			
Length for tonnage,		240 feet.	
Length on deck,		250 "	
Breadth of beam at midship section,		33 "	6 inches.
Depth of hold,		19 "	
" " to spar deck,		26 "	
Draft of water at deep load line,		14 "	
Tonnage, custom house,	1300.		
Area of immersed section at 14 feet,		440 sq. feet.	
Contents of bunkers in tons of coal,	600.		
Masts and rig—	foretopsail schooner.		
Engine—one vertical beam.—			
Diameter of cylinder,			75 inches.
Length of stroke,		11 feet.	
Boilers—two return flued.—			
Length of boilers,		32 feet.	
Breadth "		12 "	6 inches.
Diameter of shells,		11 "	2 "
Height " exclusive of steam drum,		11 "	8 "
Number of furnaces in each,	3.		
Breadth of furnaces,		3 feet	6 inches.
Length of grate bars,		7 "	6 "
Number of upper flues,	6.		
Internal diameter of upper flues,			17¼ inches.
Length of flues,		27 feet.	
Diameter of smoke pipes,		6 "	2 inches.
Height " "		48 "	
Description of coal,	anthracite or bituminous.		
Draft,	natural.		
Paddle Wheels—ordinary radial.—			
Diameter,		33 feet.	
Length of blades,		8 "	
Depth "		1 foot	6 inches.
Number "	28.		

Remarks.—Hull strapped with diagonal and double laid straps; planks edge-bolted. Floor timbers, *molded* 16 ins.; *sided* 12 ins.; apart at *centers* 24 ins.

C. H. H.

For the Journal of the Franklin Institute.

Particulars of the Steamer William Jenkins.

Hull built by John A. Robb, Baltimore; machinery by Murray & Hazlehurst, Baltimore. Owners, Merchants and Miners' Transportation Company of Baltimore. Intended service, Baltimore to Boston.

Hull.—

Length on deck,		205 feet.
Breadth of beam at midship section,		31 "
Depth of hold,		9 "
" "		10 " 6 inches.
Draft of water at deep load line,		13 "
Tonnage, custom house,	1000.	
Masts and rig—	schooner.	

Engines—

Diameter of cylinder,	56 inches.
Length of stroke,	9 feet.

Boilers—two—tubular.—

Draft,	natural.

Water Wheels.—

Diameter,	26 feet.
Length of blades,	8 " 6 inches.
Depth "	1 " 10 "
Number "	22.

Remarks.—Floors *molded* 18 ins.; *sided*, 8 ins.; distance apart *at centres*, 27 ins.

C. H. H.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, March 15th, 1855.

John C. Cresson, President, in the chair.
John Agnew, Vice President,
John F. Frazer, Treasurer,
Frederick Fraley, Corresponding Secretary,
Isaac B. Garrigues, Recording Secretary,
Present.

The minutes of the last meeting were read and approved.

Letters were read from the Institute of Actuaries of London and Ireland, and the Statistical Society of London, and the Big Spring Literary Institute, Newville, Pennsylvania.

Donations to the Library were received from the Royal Astronomical Society, and the Chemical Society, London; the Massachusetts Charitable Mechanic Association, Boston, and W. Jackson, Esq., Newton, Mass.; the Regents of the University of New York, Albany, and J. S. Dodge, Esq., Rome, N. York, Charles B. Norton, Esq., and Prof. S. F. B. Morse, City of New York; John McRea, Esq., Charleston, S. Carolina; Geo. W. Kendall, Esq., and the Young Men's Mercantile Library Association, Cincinnati, Ohio; the Kentucky Mechanics' Institute, Louisville, Ky.; the Mercantile Library Association, St. Louis, Missouri; the University of Michigan, Ann Arbor, Michigan; E. G. Waterhouse, M. V. Baker, and R. M. Foust, Esqs., Pennsylvania Legislature, and State Librarian, Pa.; Messrs. Charles Oat, and A. B. Hutton, Drs. Chas. F. Beck, and A. L. Kennedy, and the Directors of Girard College for Orphans, Philada.

The Periodicals received in exchange for the Journal of the Institute, were laid on the table.

The Treasurer's statement of the receipts and payments for March, was read.

The Actuary reported the organization of the Board of Managers, and the following Standing Committees for the ensuing year, by the election of their chairman, and appointing the time for holding their stated meetings, as follows:

Board of Managers,	Isaac S. Williams, Chairman, T. J. Weygandt, } Curators. Owen Evans, }	2d Wednesday Evening.	
Committees.			
On the Library,	George Erety, Chairman,	1st Tuesday	"
" Models,	George C. Howard, "	1st Thursday,	"
" Exhibitions,	John E. Addicks, "	" "	"
" Min's. and Geo. Specm's.,	J. C. Trautwine, "	2d Monday	"
" Meetings,	Fairman Rogers, "	" "	"
" Science and the Arts,	John C. Cresson, "	2d Thursday	"

The Board of Managers and Standing Committees reported their minutes.

The Committee on the Library reported that 322 volumes, together with a large number of pamphlets, had been added to the Library during the past year.

The candidates for membership in the Institute, (5,) were proposed, and the candidates proposed at the last meeting, (5,) were duly elected.

Dr. Rand exhibited an improved galvanometer invented by Mr. Thos. J. Weygandt. Its peculiarities consist in the arrangement of the pole-changers of the helix, which is moveable in an horizontal plane, without altering the direction of the needle; there is also an arrangement by which the needle may be raised or lowered without altering its direction, or may have its direction altered without change in its position in a vertical plane. The instrument is exceedingly delicate. It is at present under consideration by the Committee on Science and the Arts, and a detailed description will be published in a future number of the *Journal.*

Dr. Rand also exhibited some illuminating gas, made from wood in the retort patented by Dr. C. M. Cresson. This process is now in use

on the large scale at the Philadelphia Gas Works. A full description of the apparatus will be given in a future number.

Dr. Rand further presented for the inspection of the members, a copy of the *Albany Evening Journal*, of Jan. 13, 1855, printed on paper made entirely from pulp from the shavings of bass wood; the shavings were made by a machine invented by Mr. George W. Beardslee, of Albany, and the paper made at Batterlee's Little Falls Mills. Mr. Beardslee is engaged in the manufacture of paper from various kinds of woods, not restricting himself to bass wood. The process is not disclosed. The color and quality of the specimens presented were good; it was only to be distinguished from ordinary paper from rags, by a somewhat greater brittleness. Although unsized, it can be written upon without difficulty, there being no tendency in the ink to spread.

Washington Jones presented to the notice of the members a new form of mallet; the head is composed of a barrel-shaped piece of cast iron, of about three inches diameter in the middle, and three inches long. In the middle of its length is cast a hole for the reception of the handle, and in each end, a cylindrical recess of two and a quarter inches diameter, and one inch deep; into these recesses are fitted plugs of hard wood, which project beyond the casting, from one-fourth to one-half of an inch, and compose the striking faces. The advantages of the instrument are, the necessary weight is had in a small compass; the faces when battered are easily renewed, and the appearance of the tool is much neater than those made entirely of wood.

These mallets are found very useful about a machine shop, particularly upon the lathes, where they have in some of the establishments superseded hammers.

Professor Frazer explained by means of a model, the construction and advantages of Mr. Thomas T. Tasker's self-regulating hot water furnace adapted for warming buildings. The details of this invention will be given in a report on it, now before the Committeee on Science and the Arts.

H. Hochstrasser presented a novel mode of moving machinery a definite distance, by an adjustable escapement, which performs the duty of a ratchet wheel, with this advantage, it cannot by momentum be overshot, as either the upper or lower part of the escapement is confined in the spaces; when the upper part of the escapement is in the space, the lower part (working on a centre) is at an angle with the next succeeding space; so when moving up, as the upper part leaves the space it is in, the lower part enters the next succeeding space, and moves the machine just the distance of one space; in the present instance it is applied to an omnibus register and pageing machine patent. With the exception of the hammer that strikes the bell, there is no other machinery to the register than the escapement and spaces wherein it works, and no momentum or friction of any account.

The pageing machine is a spiral wheel, and would run down by the power of its own gravity if it were not kept in check by the escapement.

// JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

PROMOTION OF THE MECHANIC ARTS.

MAY, 1855.

CIVIL ENGINEERING.

Report of H. HAUPT, Civ. Eng. *Chairman of the Committee on Civil Engineering and Inventions, appointed by the Maryland Institute, on Bollman's Patent Iron Suspension Railroad Bridge*, [October, 1854.]

To form a just appreciation of the merits of any invention which professes to be an improvement, and especially to enable a correct decision to be made upon the claims of competitors to superiority, it is necessary that certain general principles be established and required as a standard to which particular cases may be referred.

In the consideration of the relative merits of mechanical inventions, it seems to be necessary first to fix and determine what is the object sought? What is that standard of perfection towards which the nearest possible approximation is attempted?

The great desiderata in the construction of bridges appears to be—

1. *Strength;* by which is understood efficiency of resistance, or the ability to sustain without danger of fracture the greatest load that can by any possibility be thrown upon the structure.

2. *Durability*, or the ability to sustain such loads at the least cost from deterioration or repairs.

3. *Rigidity*, or the powers to resist the change of figure by the action of variable loads.

4. *Incombustibility.*

5. *Economy in first cost*, which includes a minimum of materials and workmanship.

7. *Compensation for Expansion*, which is essential in all metallic bridges.

6. *Facility of Repairs*, which usually includes simplicity of construction.

It appears evident that the structure which possesses in the highest degree the essentials above enumerated, must approach most nearly to the standard of perfection.

All materials used in sustaining loads must depend for their efficiency upon their powers of resistance, and these resistances must be exerted against forces that are either tensile or compressive.

The simplest forms of these resistances are exhibited in chains and posts; beams exposed to cross strains include both.

The chain or polygon suspended between resisting points and the arch, depend for their efficiency upon their powers of resistance to tensile and compressive forces, and are evidently the most simple forms in which a given amount of resisting material can be disposed with a given rise or deflexion, and with a given span.

With a stationary load the chain or cable assumes and maintains a position of stable equilibrium; it has no tendency to change of figure, and fulfils every condition of perfect efficiency of resistance; but with variable loads it is unstable, except where there is but a single point of application of the weight, and it cannot oppose a satisfactory resistance unless connected with some other system capable of conferring upon the combination the requisite rigidity.

An arch like the suspension chain is capable of opposing an efficient resistance to any constant load, where its figure conforms to that of the curve of equilibrium for the applied weight; but unlike the catenary, its position is unstable; the smallest disturbing force would be sufficient to cause its failure, unless connected with a system capable of resisting the action of variable loads.

It is almost self-evident that where the problem is to determine the best form to sustain a given constant weight with the minimum quantity of material, the arch or the chain must be adopted as the arrangement which best fulfils this condition.

If an arch or chain can be secured against changes of figure from the action of variable loads, its sustaining power will be perfect, and as it has been shown in published works on bridge construction, that a much smaller force is sufficient at any given point to prevent changes of figure, than to sustain the load, it follows almost as a necessary consequence that the bridge which exhibits the greatest strength with a given quantity of material must depend for its sustaining power upon some application of the aid or of the suspension chain or rods.

The plan under consideration, known as Bollman's Bridge, will now be tested by an application of these principles.

1. *Strength.*—Where the material is sound, the strength of the structure will be nearly in proportion to the cross sections of the sustaining rods and stretchers, and by varying the size of their supports any required capacity for resistance can be secured.

2. *Durability.*—As the sustaining parts are of a durable material, and as the perishable portions of the structure are attached by means which admit of ready renewals without obstruction to the trade or travel which passes over it, this condition is also very satisfactorily fulfilled.

3. *Rigidity.*—The sustaining power is derived from the tensile resistance of rods, the weight upon which varies in amount, but not in the

position of its point of application so far as each system is concerned; *of course there is no tendency to change of figure in the tension rods.*

These rods are connected with the ends of the top chord or stretcher, which must be sufficient to resist the lateral flexure which the compressive forces acting upon it have a tendency to produce. This tendency is effectually resisted by the lateral bracing in a horizontal direction, and vertically by the posts and truss rods which support it. If these points of support are sufficiently near to each other the stretcher cannot yield except by crushing, which must be guarded against by a sufficient area of cross section. The arrangement therefore fulfils the condition of perfect rigidity—*there can be no change of figure except that which is due to the elasticity of the material.*

4. *Incombustibility* is secured by the nature of the material employed.

5. *Economy in first cost.*—This is a consideration of much importance, and upon it will turn the relative advantage of the various plans of construction in general use. Many of these plans possess decided merit, most of them by a proper proportion of the parts can be made to fulfil the most important conditions of an efficient structure. In fact, the combination of the arch with a counter-braced truss of any description generally gives the requisite degree of strength and rigidity; but all are not equally economical in first cost or in cost of repairs; all are not on a par in the facilities offered for renewals or in durability.

The first and most important question for consideration refers to the distribution of material in the main supports. Is the arrangement such as will give the greatest resistance with a given quantity of material?

Referring to the description of the Harper's Ferry Bridge on the Baltimore and Ohio Railroad, it appears that there are nine posts, eight panels, and seven distinct systems of support, each system acting independently of the rest, but sustaining its own share of the weight of the structure, which appears to be about one-half ton per lineal foot.

Estimated in reference to the permanent weight of the structure, the sustaining effect of these seven systems will be almost precisely the same as that of a catenarian chain or polygon containing an equal quantity of material, and the arrangement would involve no loss of material, and as a consequence, no unnecessary expenditure for this object.

But if the structure is designed to resist the action of a heavy variable load passing over it and acting separately and successively upon each of the seven systems, a wide difference will be found to exist in the results, and the proposed plan will involve a much larger expenditure of material than the arch, the single chain, or polygon.

To render this apparent, for the purpose of illustration, let w represent the weight of the structure. As there are eight panels or spaces, each of them would represent a weight of $\frac{w}{8}$ and as each system carries a weight equal to that of one panel, $\frac{7}{8}$ w will represent the weight sustained by the whole.

If a locomotive of the heaviest class pass over the bridge, the weight upon one panel or upon one of the systems of support may be about double the permanent average load for the remaining panels or supports, and if so, will be represented by $\frac{2w}{8}$.

This weight must be sustained successively by each of the seven systems, and the united power of resistance for the variable load must be

$$\frac{2w}{8} \times 7 = \frac{14w}{8}.$$

The whole sustaining power of the rods must therefore be

$$\frac{7w}{8} + \frac{14w}{8} = \frac{21w}{8}.$$

The ability to resist with perfect security a given weight for a short interval, practically insures the ability to sustain the same weight for a greater length of time, and if one of the seven systems is sufficient to sustain a locomotive while passing a single panel, it is sufficient to sustain it during the whole time of passing the bridge. An arch or a chain, under similar circumstances, sustaining the weight of the structure and of one locomotive, would be required to oppose a resistance of only

$$\frac{7}{8}w + \frac{2w}{8} = \frac{9}{8}\ w.$$

The difference in the quantity of sustaining material required in the two cases is

$$\frac{21}{8}\ w - \frac{9}{8}\ w = \frac{12}{8}\ w = 133 \text{ per cent. against the}$$

sustaining arrangement exhibited in Bollman's bridge.

But the case supposed is not that which must determine the proportion of the parts in practice. A locomotive is usually followed by a train of cars, and the weight of the train may be taken at an average of half the weight per foot of the locomotive, and equal to that of the structure; in this case, the arch or chain must sustain a load represented by

$$\frac{6}{8}w + \frac{7}{8}w + \frac{2}{8}w = \frac{15}{8}\ w.$$

The Bollman plan, requiring a sustaining power of $\frac{21}{8}$ w would in this case also involve an excess of material equal to $\frac{6}{8}$ w, or 40 per cent.

Although the expression $\frac{15}{1}$ w represents the usual load upon the bridge caused by the passage of a train, it is not the maximum load ; and it is the maximum load, and that only, which should determine the dimensions of the parts.

This load upon a railroad bridge is equal to a train of locomotives, and the sustaining power necessary to resist it is $\frac{21}{8}$ w, which is the same with the arch or catenary, as in the plan under examination.

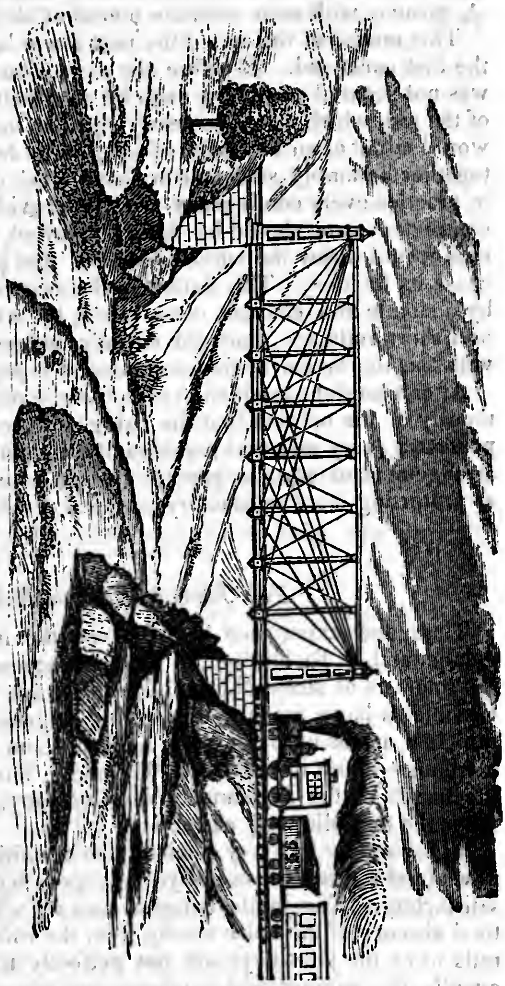
From these considerations the conclusion is deduced, that *when the maximum load is upon the bridge, the seven systems of sustaining rods require no greater amount of material than a single system capable of opposing an equal resistance.*

But a single system, whether an arch, a catenarian curve, or a polygon, requires the assistance of a truss to resist change of figure and enable it to sustain a variable load.

The arrangement in Bollman's bridge having no tendency to change of figure, requires no such assistance as far as the suspension rods are concerned, but it must be observed that these rods transmit the strains to the stretcher, which is compressed to the same extent as the arch in ordinary systems, and requires the aid of trusses both in vertical and

horizontal planes to give it the requisite stiffness. The same truss which is required to give stability to the upper chord or stretcher, would generally be sufficient to counterbrace the arch, where such an arrangement is substituted for it.

It follows, therefore, that while the Bollman plan does not require a greater sectional area to sustain the maximum load than the arch or catenary, it does not appear to require less, and that all these systems of support are nearly on an equality as respects the quantity of material requisite to sustain the maximum load.



In the details of Bollman's bridge several very meritorious arrangements are presented, one of the most valuable of which is the security against injury in the event of the fracture of any one of the main sustaining rods, the panel rods being sufficient to support the load and transmit it to the systems on each side. This advantage is of course secured by an additional expenditure of material, but the benefits are amply sufficient to compensate for it.

No data have been furnished by which to compare the cost of bridges on this plan, with others of equal strength, but it is believed that no material differences can exist where the proportions are properly adjusted.

The sixth requisite in a good plan of bridge is the ability to make repairs with facility; in this respect the plan under examination is unexceptionable.

The last essential, and one which is indispensable in a metallic structure, is the power of compensation for changes produced by variations of temperature.

From the published record of observations at the Harper's Ferry bridge, it appears that the variation in the length of the structure from changes of temperature amounts to $\frac{5}{8}$ of an inch.

The variation of the rods from the usual tables of expansion should be about 1 inch, making an uncompensated difference of $\frac{3}{8}$ in the whole length.

The observed motive difference at the first post was $\frac{3}{16}$ of an inch towards the short rod, a difference which would probably have been found $\frac{1}{16}$ greater, with more accurate means of observation.

This motion of the end of the post towards the short rod is resisted by the first panel rod. If before the expansion took place this panel rod was not secured so tightly as to be in a state of tension, the expansion of the rod, which would be nearly $\frac{3}{16}$ of an inch, and the elasticity which would admit of an extension of $\frac{1}{1400}$ of its length without injury, would together be amply sufficient to provide the requisite compensation; but in practice every contingency must be provided for, and if the rod in its contracted state should be tightly screwed, the expansion of the long rods would throw the whole weight at that point upon it, and probably cause its fracture. This defect in the original plan has been obviated by a simple and efficient contrivance, by which the action of the long and short rods are rendered entirely independent of each other, and with this improvement the *compensation is perfect in every part.*

After a careful examination of the whole subject, the Judges are unanimously of the opinion that the Bridge constructed by Wendal Bollman possesses every essential requisite of an efficient structure, and that no arrangement of parts in general use can be considered superior to it, or as promising more satisfactory practical results.

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*Fish Joints in Rails on Railroads.**

Time and experience have proved the invention of Messrs. W. B. Adams and R. Richardson, to be most successful, and most fortunate for the interests of shareholders. The little fish-joint has saved the Eastern Counties a large amount of working expense; indeed, it has been a principal means of making dividend for them. The cost of fish-jointing is trifling—about or under £200 a mile. This valuable invention is in the hands of the Permanent Way Company, from whose account of it we make the following extracts:—

"This simple but very efficient plan of uniting the ends of the rails has now stood the test of several years' experience, and the result is highly satisfactory. The joints being accurately adjusted, there is an almost total absence of the noise arising from the wheels striking the ends of the rails when the joint-keys are not perfectly tight in the chairs; consequently the engines and carriages run smoothly and with diminished oscillation, an effect that is frequently remarked by passengers, who are not acquainted with the cause, but who judge only by the greater comfort in traveling over a line so jointed.

"It is obvious that if percussion and oscillation are diminished, a saving in wear and tear of rolling stock must be the consequence, although it is not possible to estimate the precise money-value of such saving, in consequence of the carriages having to run over railways of every variety

* From Herapath's Journal, No. 808.

of construction, and a portion only of the lines of this kingdom being as yet fish-jointed.

"The same cause which lessens the wear and tear of rolling stock makes the rails last longer; and a more accurate estimate may be formed of the economy in this important part of railway construction. Experience proves that the increased duration of fished rails may be safely estimated at 25 per cent., probably even more: rails on the Eastern Counties line, considered very nearly worn out, were fished three years ago, and are still existing in fair order and under heavy traffic. It is equally obvious that the economy must extend to the sleepers and maintenance of way. In the latter item we are able to come to actual results, by a knowledge of the reduction in labor: and this is found, by the accounts of more than three years, to amount to one-half the sum previously paid.

"This statement is made on the authority of the half-yearly accounts of the Eastern Counties Railway, upon which line the system was first tried on a large scale, and it is corroborated by the fact that a contract for the maintenance of 140 miles of the main line of the Midland Railway has lately been let, one of the conditions being, that those parts of the line which are fish-jointed (together with some other portions laid under the Permanent Way Company's patents) are charged £50 per mile per annum less than the road of the old construction.

"The advantages obtained by fish-jointing may be stated to consist in—

"1st. A saving in the cost of labor for maintenance, of at least 40 per cent.

"2d. Increased durability of rails at least 25 per cent., and probably as much upon the sleepers.

"3d. A saving in wear and tear of rolling stock.

"4th. Less power being required for traction, a consequent saving of coke to produce that power.

"5th. The avoidance of accidents arising from bad joints.

"6th. Greatly increased comfort to the passengers.

"7th. Higher speeds may be used with equal safety."

For the Journal of the Franklin Institute.

Disquisition on the Laws regulating the Slips of Screw Propellers in function of Form and Dimensions; based on a Digest of the Experiments made in 1845 *by M. Bourgeois, Engineer de Vaisseau, at the French Government Manufactory at Indret.* By B. F. Isherwood, Chf. Eng. U. S. Navy.

(Continued from page 231.)

Of the influence exerted on the Slip by the employment of an oblique Generatrix.

In order to determine the effect of an oblique generatrix, an experiment was made on screw P, which screw had the following dimensions, viz:

Diameter,	15·75 inches.
Diameter of hub,	2·95 "
Pitch,	35·43 "
Length on axis,	3·39 "
Area of the screw projected on a plane at right angles to axis,	72· sq. inches.
Number of blades,	4.
Fraction used of the pitch,	0·391.

This screw was full threaded, the generatrix was straight and tangent to an inner cylinder, the blades being inclined 100° and 80° to the plane of the axis. The directrix was curved. With this screw two double courses were ran, propelling with the obtuse face of the blades; *the mean slip was* 32·8 *per centum;* minimum 31·4, maximum 34·3 per centums.

The blades were then shifted so as to propel with the acute face, and two double courses ran; *the mean slip was* 33·0 *per centums,* minimum 32·0, maximum 34·1 per centums.

The same screw, but having its generatrix straight and normal to the axis of the cylinder, was then experimented with. The mean of three double courses ran gave a slip of 34·5 per centum; minimum, 30·7; maximum, 37·1 per centums.

From the above trials, it is evident, that an oblique generatrix exercised no influence on the slip of the screw, as the mean slip when propelling with the obtuse, acute, and normal faces, were respectively 32·8, 33·0, and 34·5 per centum, which may be taken as experimentally equal.

Of the Influence exerted on the Slip by the employment of a curved Directrix or expanding Pitch.

The experiments made with three screws of widely differing proportions, are accepted for the determination of the influence exerted on the slip of the screw by curving its directrix, or giving it an expanding pitch. The experiments were made with each screw, first by propelling with its pitch in the normal position; that is, having the least pitch at the anterior edge of the blade:—then by reversing the screw on its axis and propelling with the greatest pitch at the interior edge:—and, finally, by taking the curvature out of the directrix, which was thus made straight and of a pitch equal to the mean pitch of the curved directrix. By this mode of experimenting, it is plain, that the influence of the expanding pitch can be correctly arrived at; for were that influence nothing, the screw would give sensibly the same slip with either pitch at the anterior edge, or with an uniform pitch throughout equal to the mean of the expanding pitch. If an influence was exercised it would be shown by the difference between the slip when propelling with the least and with the greatest pitch at the anterior edge of the blade; the slip with the uniform mean pitch being a mean between them. The following table contains the data and results of these experiments, viz:

Diameter of the screw.	DIAMETER. Diameter of the screw, in inches.	DIAMETER. Diameter of the hub, in inches.	PITCH. Pitch (mean) of the screw, in inches.	PITCH. Fraction used of the pitch.	PITCH. Ratio of the pitch to the diameter of the screw, the diameter being unity.	Number of blades of the screw.	Length of the screw in the direction of the axis, in inches.	Projected area of the screw on a plane at right angles to axis, in square inches.	Number of double courses ran.	SLIP. Mean slip of the screw in per centums of its speed.	SLIP. Minimum and maximum slips of the screw, in per centums of its speed.	Generatrix.	Remarks.
Q	13·62	2·95	17·32	1·000	1·27	5	3·46	139	6	26·2	23·8 28·9	Straight and normal to axis.	Screw in normal position.
	"	"	"	"	"	"	"	"	6	45·5	44·6 47·9	" " "	Screw in reversed position.
	"	"	"	"	"	"	"	"	6	31·4	30·0 33·8	" " "	Screw with pitch made uniform.
R	15·75	2·94	19·69	1·000	1·25	5	3·94	183	6	20·0	18·3 22·4	Straight and normal to axis.	Screw in normal position.
	"	"	"	"	"	"	"	"	3	32·3	32·0 32·5	" " "	Screw in reversed position.
	"	"	"	"	"	"	"	"	6	24·3	22·8 25·9	" " "	Screw with pitch made uniform.
S	15·75	2·95	35·45	0·381	2·25	4	3·38	72	3	34·5	30·7 37·1	Straight and normal to axis.	Screw in normal position.
	"	"	"	"	"	"	"	"	1	56·9	—	" " "	Screw in reversed position.
	"	"	"	"	"	"	"	"	2	42·0	42·0 42·0	Curved slightly.	Screw with pitch made uniform.

With screw Q the curvature of the directrix of each blade was such, that tangents at the extremities made with the chord an angle of 8° at the anterior, and 10° at the posterior edge. The mean of the slips of the trials made first with the least and then with the greatest pitch at the anterior edge was $\left(\frac{26{\cdot}2+45{\cdot}5}{2}=\right)$35·8 per centum, or a little more than the slip 31·4 per centum, with the uniform pitch equivalent to the mean of the expanding pitch.

With screw R the curvature of the directrix is not given, but must have been nearly the same as screw Q. The mean of the slips of the trials made first with the least and then with the greatest pitch at the anterior edge was $\left(\frac{20{\cdot}0+32{\cdot}3}{2}=\right)$26·1 per centum, or a little more than the slip 24·3 per centum, with the uniform pitch equivalent to the mean of the expanding pitch.

With screw S the curvature of the directrix of each blade was such, that tangents at the extremities made with the chord an angle of 8°. The mean of the slips of the trials made first with the least and then with the greatest pitch at the anterior edge was $\left(\frac{34{\cdot}5+56{\cdot}9}{2}=\right)$45·7 per centum, or a little more than the slip 42·0 per centum, with the uniform pitch equivalent to the mean of the expanding pitch.

The differences between the slips of the screws when propelling with the straight directrices and when propelling with the curved directrices, taking for comparison the mean of the slips with the latter, were as follows, viz:

Designation of the screw.	Slip with the straight directrices.	Mean slip with the curved directrices, normal and reversed.	Difference, in per centums of the slip with the straight directrix.
Q.	31·4	35·8	14·0
R.	24·3	26·1	7·4
S.	42·0	45·7	8·8
Means,	32·6	35·9	10·1

From which we see, that the mean slip with the curved directrices, normal and reversed, was one-tenth more than with the straight directrices, whose pitches were equal to the mean pitches of the curved directrices. Supposing the experiments to be strictly correct, this would show that the *actual propelling* mean pitch with the curved directrices was one-tenth greater than with the straight directrices; a result which might have been expected from the fact, that when propelling with the greatest pitch at the anterior edge, the portion of the surface with the least pitch at the posterior edge must be exercising but very little propulsive effort; while when propelling with the least pitch at the anterior edge, the portion of the surface with the greatest pitch at the posterior edge must be exerting a very considerable propulsive effort. The *real propelling* mean pitch

when first the least and then the greatest pitch is used at the anterior edge, must be greater than the single average of these two pitches, which result we find to be the case by the experiments. This simple average may express exactly the *real propelling* mean pitch when the least pitch is used at the anterior edge; but it evidently cannot, from the nature of things, when the greatest pitch is so used.

There remains to compare the difference between the slips of the screws with curved directrices and propelling normally with the least pitch at the anterior edge, and the slips of the same screws with straight directrices whose uniform pitches equal the simple average of the least and greatest pitches of the screws with curved directrices. This is done as follows, viz:

Designation of the screw.	Slip with the straight directrices.	Mean slip with the curved directrix, propelling normally.	Difference in per centums of the slip with the straight directrices.
Q.	31·4	26·2	16·6
R.	24·3	20·0	17·7
S.	42·0	34·5	17·9
Means.	32·6	26·9	17·4

From the above we see, that with screws Q, R, and S, the employment of the curved directrix gave for a mean, a decreased slip of 17·4 per centum of the slip with the straight directrix, or, in round numbers, say a decreased slip of one-sixth; that is to say, if a screw with straight directrix gave a slip of 30 per centum, it would give with a curved directrix whose mean pitch equaled the pitch with the straight directrix and whose curvature was such that the tangents at the extremities of the blade made angles of 8° with the chord, a slip of 25 per centum. The amount of decrease in the slip will, of course, depend on the absolute slip of the screw and on the degree of curvature given to the directrix; too great a curvature can be given, for the initial pitch may be made relatively to the final pitch so small that its longitudinal speed will be exceeded by the speed of the vessel, when no propelling effect would be exercised by that portion of the blade on the water.

Of the Influence exerted on the Slip by the diameter of the Screw.

For the determination of the influence exerted on the slip of the screw by the length of its diameter, we can compare the results from screw H, 5th series, table I, with the results from the screws of the 1st series, same table. Also, the results from the screws of the 4th series, table II, with those from the screws of the 2d series, same table. And, finally, we can compare the results of screw Q with those from screw R.

And first, comparing the screws of the 1st and 5th series, table I. Now as the screws of the 1st series give consistent results, it is only necessary to take screw F, the one most nearly resembling screw H in amount of slip, number of blades and ratio of the diameter to the pitch, and compare its results with the results of screw H. The pitch of screw F is 31·50

inches and its slip is 35·6 per centum; the pitch of screw H is 24·25 inches; the ratio of the pitches is therefore $\left(\frac{31\cdot50}{24\cdot25}=\right)$ 1·3, and if the two screws had been of the same diameter the slip of H would have been $\left(\frac{35\cdot6}{1\cdot3}=\right)$ 27·4 per centum, but it actually was 35·7 per centum, the ratio being $\left(\frac{35\cdot7}{27\cdot4}=\right)$ 1·303. Now the diameter of screw H was 13·62 inches, and of screw F 15·75 inches, the ratio being $\left(\frac{15\cdot75}{13\cdot62}=\right)$ 1·156, the square of which is 1·336, or nearly the same as 1·303. We therefore see, that other things equal, the slip of the screw decreases in the ratio of the square of the diameter.

Again, let us compare screw L, 2d series, table II, with screw N of the 4th series, same table; these screws resembling each other in number of blades and ratio of the diameter to the pitch. The pitch of screw L is 39·37 inches and its slip is 52·6 per centum; the pitch of screw N is 30·71 inches, the ratio of the pitches is therefore $\left(\frac{39\cdot37}{30\cdot71}=\right)$ 1·282, and if the two screws had been of the same diameter the slip of N would have been $\left(\frac{52\cdot6}{1\cdot282}=\right)$ 41·0 per centum, but it actually was 60·3 per centum, the ratio being $\left(\frac{60\cdot3}{41\cdot0}=\right)$ 1·471. Now the diameter of screw N was 12·28 inches, and of screw L 15·75 inches, the ratio being $\left(\frac{15\cdot75}{12\cdot28}=\right)$ 1·282, the square of which is 1·643. The discrepancy here is between 1·471 and 1·643, or ten and a half per cent. of the greater number.

If we compare screw O of the 4th series, which was of the same diameter as screw N, with screw K of the 2d series, which resembled it in number of blades and in the ratio of the diameter to the pitch, and which had the same diameter as screw L, making the comparison as above, we find that had screw O been of the same diameter and pitch as screw K, its slip would have been 29·5 per centum, but it actually was 43·6 per centum, the ratio being $\left(\frac{43\cdot6}{29\cdot5}=\right)$ 1·478. The squares of the diameters of the two screws compared as 1·000 to 1·643, the discrepancy being here also, as in the immediately preceding case, ten and a half per cent. of the large number.

Finally, let us compare screw Q with screw R, taking for comparison the results when propelling with uniform pitches. The pitch of screw R is 19·69 inches, and its slip is 24·3 per centum; the pitch of screw Q is 17·32 inches; the ratio of the pitches is therefore $\left(\frac{19\cdot69}{17\cdot32}=\right)$ 1·137, and

if the two screws had been of the same diameter the slip of Q would have been $\left(\frac{24 \cdot 3}{1 \cdot 137}=\right)$ 21·4 per centum, but it actually was 31·4 per centum, the ratio being $\left(\frac{31 \cdot 4}{21 \cdot 4}=\right)$ 1·467. Now the diameter of screw Q was 13·62 inches, and of screw R 15·75 inches, the ratio being $\left(\frac{15 \cdot 75}{13 \cdot 62}=\right)$ 1·156, the square of which is 1·336. The discrepancy here is between 1·467 and 1·336, or nine per centum of the greater number.

If, now, we take from the foregoing experiments, the mean of the ratios between the actual slips and the slips that would have been, had the compared screws been of equal diameter and pitch, and compare it with the mean of the ratios between the squares of the diameters, we shall obtain the following result, viz:

Compared screws.	Ratios of the actual slips to the slips that would have been, had the compared screws been of equal diameter and pitch.	Ratios of the squares of the diameters of the compared screws.
F and H.	1·303	1·336
L " N.	1·471	1·643
O " K.	1·478	1·643
Q " R.	1·467	1·336
Means.	1·43	1·49

From the close agreement of these means (1·43 and 1·49) it may be considered as experimentally determined, that the slip of the screw decreases in the ratio that the square of the diameter increases, other things continuing equal, and *vice versa.*

Of the Influence exerted on the Slip by surrounding the periphery of the Screw with a Drum of very thin metal fastened to and moving with the Blades.

Many mechanicians have entertained the notion, that the screw in its rapid rotation endows the water comprised between its blades, with a centrifugal force, and that this water thrown violently from the centre towards the circumference, leaves a vacuum about the axis, which diminishing the propelling surface of the screw increases correspondingly its slip—and that by surrounding the circumference of the screw with a thin metal band or drum, this radial movement of the water existing in virtue of the imagined centrifugal force impressed upon it by the rotation of the screw, might be forcibly repressed, so that the vacuum should not obtain at the axis, but the whole surface be maintained in its propulsive action on the water.

To test this idea practically, screw Q was experimented with, propelling by its reversed face, that is to say, having the greatest pitch at the anterior and the least pitch at the posterior edge of the blades. Two double courses were ran, and the resulting slips were 44·1 and 45·8 per centum: *mean slip* 45·0 *per centum.*

The periphery of this screw was then surrounded with a thin copper drum, and the experiments were carefully repeated, propelling with the same face as before. Two double courses were ran, and the resulting slips were 47·0 and 48·0 per centums: *mean slip* 47·5 *per centum.*

The drum was now removed from this screw, the curvature of the directrix was considerably reduced, and propelling with the same face as before, three double courses were ran, giving slips of 38·3, 38·3, and 39·6 per centum: *mean slip* 38·7 *per centum.*

The drum was now restored, and propelling with the same face as before, two double courses were ran, giving slips of 41·8 and 42·9 per centum: *mean slip* 42·3 *per centum.*

If, now, in the above experiments we take the mean of the two with the drum attached to the screw, we shall obtain a slip of $\left(\frac{47{\cdot}5+42{\cdot}3}{2}=\right)$ 44·9 per centum: while the mean of the two made without the drum gives $\left(\frac{45{\cdot}0+38{\cdot}7}{2}=\right)$ 41·9 per centum. The increased slip of one-fourteenth resulting from the attachment of the drum, must be considered as due to the direct resistance of the edge of the drum and to the friction of the surface of the drum on the water. We then arrive at the conclusion, that the envelopment of the periphery of the screw by a drum, exerts no influence on the slip in function of form.

General Practical Conclusions.

By the experiments just discussed, there have been established the following *conclusions* with regard to the laws regulating the slip of the screw in function of its form and dimensions, viz:

1. *With regard to the influence exerted on the slip by the cutting out of the inner part of the blades.* That a cutting out of the inner portion of the blades, by the passage of a cylinder having the same axis with the screw and a diameter equal to half the diameter of the screw, increased the slip one-seventh; that is to say, if the slip before the cutting out was 28 per centum, it would be 32 per centum after the cutting out. Also, that a further cutting out of the inner portion of the blades, by the passage of a cylinder of coincident axis and of a diameter equal to three-fourths the diameter of the screw, increased the slip two-fifths; that is to say, if the slip of the full threaded screw before the cutting out was 28 per centum, it would be 39 per centum after the cutting out.

2. *With regard to the influence exerted on the slip by employing less than one convolution of the thread, or by fractioning the pitch.* That supposing the original screw to consist of one convolution of the thread divided into several blades, the effect upon the slip is the same for equal fractionments of the pitch, whether that fractionment be effected by the omission of blades, preserving the same length of screw, or by the diminution of the length of the screw, preserving the same number of blades, viz: that an increase of slip follows each decrease of screw surface: that this increase of slip follows no regular ratio of the decrease of surface of the screw, but is large for small fractions of the pitch, becoming gradually

very small for large fractions of the pitch; that the mean of the experiments determines the following for the ratio of the increase of slip in the case where the original one convolution of the thread was decreased successively by one-seventh at a time, viz:

Fractions used of the pitch.	Ratio of the increase of the slips.	Relative slips, supposing the slip with one convolution of the thread to be 30 per centum.
7-7 or 1·000	1·0000	30·000
6-7 or 0·857	1·0024	30·072
5-7 or 0·714	1·0369	31·107
4-7 or 0·571	1·0777	32·331
3-7 or 0·429	1·1492	34·476
2-7 or 0·286	1·2626	37·878
1-7 or 0·143	1·4463	43·389

That within the limits of one convolution of the thread and with the same screw, halving the same surface either by reducing the length one-half or by omitting one-half the number of blades, increases the slip in the same ratio, and this ratio is constant, be the absolute amounts of surface what they may; and that the ratio of this increase of slip for such a reduction of one-half the surface is 1·151 or two-thirteenths: for instance, if using *six*-sevenths of one convolution give a slip of 30 per centum, then using *three*-sevenths of the same convolution will give a slip of ($1·151\times30=$) $34\frac{1}{2}$ per centum; if using *two*-sevenths of one convolution give a slip of 39 per centum, then using *one*-seventh of the same convolution will give a slip of ($1·151\times39=$) 45 per centum, and so on.

3. *With regard to the influence exerted on the slip by employing an oblique generatrix.* That the employment of a straight line for generatrix, having its inner end tangent to an inner cylinder of the same axis as the screw, so that it made angles of 100° and 80°, with a plane passing longitudinally through the axis, exerted no sensible influence on the slip of the screw; and as a curved generatrix is only an oblique generatrix with a constantly varying degree of obliquity, it follows that no sensible influence on the slip would be exerted by a curved generatrix.

4. *With regard to the influence exerted on the slip by employing a curved directrix or expanding pitch.* That the employment of a curved directrix with such a degree of curvature that the tangents at the extremities of the blade made angles of 8° with the chord, decreased the slip of the screw one-sixth; that is to say, if a screw with a straight directrix or uniform pitch gave a slip of 30 per centum, then the same screw but with a curved directrix whose mean pitch equaled the pitch of the straight directrix, would give a slip of 25 per centum; the curvature of the directrix being as above described and the slip being calculated for the mean pitch.

5. *With regard to the influence exerted on the slip by the division of the same propelling surface into a more or less number of blades.* That the slip of the same area of the same propelling surface remains unaltered, whether that surface be arranged in one blade or many.

6. *With regard to the trepidations of the screw.* That when the propelling surface is arranged in *one* blade, the trepidations are *very strong;* when arranged in *two* blades, *light;* when arranged in *three* blades, *nearly insensible*, and when in *four* blades they entirely *ceased.*

7. *With regard to the influence exerted on the slip by the greater or less rotary speed of the same screw.* That the slip of the same screw remained constant at all rotary velocities, the speed of the boat being in the direct ratio of the number of revolutions made by the screw in a given time.

8. *With regard to the influence exerted on the slip by surrounding the periphery of the screw with a thin metallic drum of the same length as the screw, fastened to the blades and turning with them.* That the application of such a drum produces no effect on the slip.

9. *With regard to the influence exerted on the slip by arranging the blades checkerwise.* That the arrangement of the blades checkerwise, which is done by taking half the number of the blades, moving them back their length, and positioning them so that the rear blades intersect the spaces between the front blades, which arrangement causes the screw to be of double length in the direction of the axis, exerts no influence on the slip of the screw.

10. *With regard to the influence exerted on the slip by the length of the pitch.* That the slips of otherwise equal screws are in the direct ratio of the pitches; that is to say, doubling the pitch doubles the slip.

11. *With regard to the influence exerted on the slip by the length of the diameter of the screw.* That the slips of otherwise equal screws are in the ratio of the squares of the diameters; that is to say, halving the diameter increases the slip four times.

(To be Continued.)

For the Journal of the Franklin Institute.

Remarks on W. TRURAN'S *Article on Errors committed by Writers on Mechanical Engineering.* By THOMAS PROSSER, Civ. Eng.

In the March number of the *Journal*, is an article on "*Errors committed by writers on Mechanical Engineering*," by WILLIAM TRURAN, Esq., which is certainly astonishing, not for the errors which it exposes, but for those which it commits.

The quoted assertion of Desaguliers, that "two men working at a windlass with handles at right angles to each other, can raise 70 lbs. more easily than one can raise 30 lbs.," has reference only to their physical organization, which is supposed to enable them to work with greater advantage when one man is laboring most and the other least, and thus equalizing the labor or strain at certain points, which otherwise would test the strength too severely to be endured; just as a man may in some cases perhaps, lift or carry 60 lbs. 70 feet with greater ease than 70 lbs. 60 feet, although the mere mechanical performances are precisely equal. That "the majority of educated scientific men in Europe believe that a gain of power follows, when the handles of a windlass are set at right angles &c.," is a most extraordinary assertion of credulity on the part of the writer.

The gratuitous addition of C. E. to the name of the late J. C. Robertson, Esq., is very significant of the writer's accuracy, and would certainly amuse the recipient, were he alive to enjoy the joke.

Mr. Robertson was a writer to the Signet in Scotland. In 1823 he commenced the editorship of the *London Mechanics' Magazine*,* and in 1835 he connected with it a Patent Agency business. He died Sept. 25th, 1852, and this is, I believe, the first obituary notice that has ever appeared in any *Scientific Journal*, of the man, who, before the London Mechanics' Institute was established, advocated and encouraged the claims of mechanics, and identified himself with that Institute from its commencement—the man who received the highest encomiums from Dr. Birkbeck and Henry Brougham, Esq., M. P. and F. R. S., himself the most accomplished mechanic that ever argued a Patent Case in a silk gown, or sat upon a woolsack—now Lord Brougham.†

Desaguliers alludes to the "easily" doing of a thing, not to the power required to do it. One may do a thing, which another cannot do at all, or the same man do a thing one way which he cannot do another, while the absolute mechanical power which is required to do it remains precisely the same.

The quotation from Robertson I cannot find, but the language is very indefinite and quite unlike that which he usually employed in writing upon subjects which he understood, which were certainly not those alluded to; at least, he was not so eminent as has been stated, apparently in order to make out a case.

The placing of cranks at right angles to each other, was, I believe, first introduced by Bolton & Watt, nearly 50 years ago, in a rolling mill. The object in view, was, to avoid the dead centres which exist when one engine only is employed, and also to use a lighter fly-wheel to equalize the motion, a most important consideration too in a cotton mill, particularly where very fine numbers are spun. The first steamboat with two engines, was upon the Clyde, in 1813, built also by Bolton & Watt, and had the cranks placed at right angles to each other.

It is only on a locomotive, that I fancy any power is gained by placing the cranks at right angles to each other, and that is the power of throwing the engine off the rails, particularly when well "backed up" by a considerable elevation of the outer rail on going round a curve. One engine pulls on one side, and then the other reciprocates it at intervals on the other side, which, being favored by the elevation of the outer rail upon a curve, sets the engine and train rocking until it not unfrequently rocks itself off. Mr. Stephenson took some such view of the

* In the first Vol., he noticed in his Report of the proceedings for the establishment of the London Mechanics' Institute, of which he was one of the Secretaries, that one of the speaker's mode of pronouncing some words, excited a smile, and his friends must have smiled on reading it, for his own pronunciation was, for an educated man, the broadest of Scotch, and so continued until the day of his death. He was of a kindly and social disposition, but a hard worker withal.

† The man who originated almost, the London Mechanics' Institute, and who had therefore, if for nothing else, a right to say that "he had done the State some service," and who died in its "harness," received not one passing notice from the press, on his demise, and even the offspring which he had raised with so much anxiety and solicitude, shed not the tribute of a tear of printers' ink upon its pages, to announce to the world that its progenitor had departed this life at the age of 67.

matter when he invented his three cylinder locomotives, which, notwithstanding his high reputation, the necessity for is scarcely as yet acknowledged. And, therefore, I do not expect to make converts to the proposition which I advanced several years ago, and for the doing of which I have only obtained the abuse of those who assume to be the elite of railway engineering

New York, April 2, 1855.

For the Journal of the Franklin Institute.

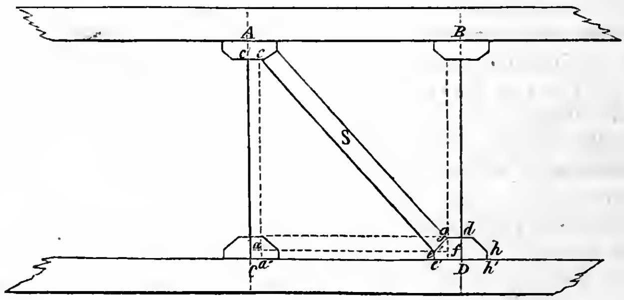
Investigation of the Angle-Block of Howe's Truss. By J. M. Richardson.

A point of great practical importance in construction is, that all the parts should fit; so that, when put together, they may constitute a perfect whole. Under-pinning, or wedging and keying, to remedy any deficiency of length, breadth, or thickness of the components, is in the highest degree deleterious, and always endangers the stability of the structure. The dimensions, therefore, of each part should be accurately determined beforehand, and no one should be received which does not correspond, in every particular, with the conditions previously ascertained.

With the view of contributing my mite towards perfecting the details of bridge construction, I submit the following general investigation of the angle-block of Howe's Truss, the diagonal brace being perpendicular to the abutting surfaces of blocks.

The quantities given in this investigation are, the distance between the upper and lower strings, the width of bay or pannel, width of brace, height of block, and distance between abutting surfaces of block.

The quantity to be determined is, the degree of inclination of abutting surfaces of blocks.



Let A B C D be a panel of Howe's truss. $AB = d'$; $AC = d''$; $Ac' = c'$; cc' = half distance between abutting surfaces of block $= e$; $eg = c$; $ef = x$; $fg = y$.

$ac = d''; -2c' + y = b + y$; $ae = d' - 2e - x = a - x$.

The right triangles, aec and efg, are similar, and give the proportion, $ef : fg :: ac : ae$, or $x : y :: b + y : a - x$. Hence,

$$ax - x^2 = by + y^2. \qquad - \quad - \qquad (1)$$

From efg,

$$x^2 = c^2 - y^2. \qquad - \quad - \quad - \qquad (2)$$

From (1) and (2),

$$x = (b\,y + c^2)\,a^{-1}. \qquad (3)$$

The limits of y are $y = o$, and $y = c$. When $y = o$, $c = o$, or $c = a$, and

$$x = o, \text{ or } x = a. \qquad (4)$$

When

$$y = c,\ b = -c, \text{ and } x = o. \qquad (5)$$

If $y = m\,c$ where m is fractional,

$$x = (b\,m\,c + c^2)\,a^{-1}. \qquad (6)$$

Solving (1) with regard to x,

$$x = 2^{-1}\left(a \pm [a^2 - 4\,(y^2 + b\,y)]^{\frac{1}{2}}\right). \qquad (7)$$

Substituting in (2) and reducing

$$y = -c\,(a^2 + b^2)^{-1}\,[b\,c \mp a\,(a^2 + b^2 - c^2)^{\frac{1}{2}}]. \qquad (8)$$

Putting this value of y in (3) there results,

$$x = a^{-1}\,c\,(c - b\,(a^2 + b^2)^{\frac{1}{2}}\,[b\,c \mp a\,(a^2 + b^2 - c^2)^{\frac{1}{2}}]). \qquad (9)$$

Having found x and y, the inclination of abutting surface of block becomes known; for, if we denote the angle, $g\,e\,f$, by ϕ, we get

$$\tan.\ \phi = y\,x^{-1}. \qquad (A)$$

Also, if l is the length of the brace,

$$l = [\,(b + y)^2 + (a - x)^2]^{\frac{1}{2}}. \qquad (10)$$

The greatest width of block is,

$$e'\,h' = 2\,e + 2\,x = 2\,e + 2\,a^{-1}\,c\,(c - b\,(a^2 + b^2)^{-1}\,[b\,c \mp a\,(a^2 + b^2 - c^2)^{\frac{1}{2}}]). \qquad (11)$$

If $a\,a' = o$, the height of the block is the unknown quantity, y, and equation (1) becomes

$$a\,x - x = a''\,y - 2\,y^2. \qquad (12)$$

From (2) and (12),

$$x = (c^2 + d''\,y - 2\,y^2)\,a^{-1}. \qquad (13)$$

The limits of x and y are the same as before, and if $y = m\,c$,

$$x = (c^2 + c\,d''\,m - 2\,c^2\,m^2)\,a^{-1}. \qquad (14)$$

Solving (12) with regard to x,

$$x = 2^{-1}\left(a \pm [a^2 + 4\,(y^2 - d''\,y)\,]^{\frac{1}{2}}\right). \qquad (15)$$

Substituting in (2) and reducing

$$y^4 - d''\,y^3 + 4^{-1}\,(a^2 + d''^2 - 4\,c^2)\,y^2 + 2^{-1}\,c^2\,d''\,y = 4^{-1}\,c^2\,(a^2 - c^2). \qquad (16)$$

(16) may be put under the form

$$y^4 + b'\,y^3 + c'\,y^2 + d'\,y = e'. \qquad (17)$$

which is the general of the equation of the 4th degree.

In (17) put

$$y = 2 - 4^{-1}\,b'. \qquad (18)$$

Reducing

$$2^4 + p\,2^2 + q\,2 = r. \qquad (19)$$

in which

$p = c' - 6\cdot4^{-2}\,b'^2$, $q = 2\cdot4^{-2}\,b'^3 - 2^{-1}\,b'\,c' + d'$, $r = e' + 3\cdot4^{-4}\,b'\,d' + 4^{-1}\,b'\,d' - 4^{-2}\,b'^2\,c'$.

Assume

$$2 = s + t. \qquad (20)$$

(19) then becomes

$$s^4 + s^2\,(6\,t^2 + p) + t^4 + p\,t^2 + q\,t + s\,(4\,t^3 + 2\,p\,t + q) + 4\,t\,s = r. \qquad (21)$$

Since but one condition has been placed on s and t, we are at liberty

to impose another; let the sum of the terms involving the odd powers of s, equal zero. Reducing, we get

$$3^2 = -(t^2 + 2^{-1} p + 4^{-1} q\, t^{-1}). \qquad - \qquad (22)$$

(21) now becomes

$$s^4 + 3^2 (6\, t^2 + p) + t^4 + p\, t^2 + q\, t = r. \qquad - \qquad (23)$$

Eliminating s between (22) and (23),

$$t^6 + 2^{-1} p\, t^4 + 16^{-1} (p^2 + 4\, r)\, t^2 = 16^{-1} q^2. \qquad - \qquad (24)$$

(24) is of the 6th degree, but may be reduced to the 3d, since it contains none but even powers of t. Assume

$$t^2 = 4^{-1} u. \qquad - \qquad - \qquad - \qquad (25)$$

(24) now becomes

$$u^3 + 2\, p\, u^2 + 4\, (p^2 + 4\, r)\, u = 4\, q^2. \qquad - \qquad (26)$$

$$\text{or, } u^3 + m\, u^2 + n\, u = v. \qquad - \qquad - \qquad (27)$$

$$\text{Let } u = 2^1 - 3^{-1} m. \qquad - \qquad - \qquad (28)$$

Reducing

$$2'^3 + p'\, 2' = r'. \qquad - \qquad - \qquad (29)$$

Where

$$p' = n - 3^{-1} m^2\; r = v + 3^{-1} m\, n - 2{\cdot}27^{-1} m^3. \qquad (30)$$

$$\text{Let } 2' = s' + t'. \qquad - \qquad - \qquad (31)$$

After reduction, (29) will become

$$s'^3 + t'^3 + (3\, s'\, t' + p')\, (s' + t') = r'. \qquad - \qquad (32)$$

Since s' and t' have been subjected to but one condition, we are at liberty to impose a second. Let

$$3\, s'\, t' + p' = o. \qquad - \qquad - \qquad (33)$$

(32) becomes

$$s'^3 + t'^3 = r'. \qquad - \qquad - \qquad (34)$$

Eliminating t' between (33) and (34),

$$s'^6 - r'\, s'^3 = 27^{-1} p'^3. \qquad - \qquad - \qquad (35)$$

Solving (35) as a quadratic,

$$s' = (2^{-1} [r' \pm (r'^2 + 4{\cdot}27^{-1} p'^3)^{\frac{1}{2}}])^{\frac{1}{3}}. \qquad - \qquad (36)$$

Substituting in (34) we get

$$t' = (2^{-1} [r' \mp (r'^2 + 4{\cdot}27^{-1} p'^3)^{\frac{1}{2}}])^{\frac{1}{3}}. \qquad - \qquad (37)$$

Now, we can find z', then u, s, t, and z, and finally x and y. Substituting the value of z', found from (36) and (37), in (28), we get one root of (27). Denote this root by u', then from (25),

$$t = \pm 2^{-1} u'^{\frac{1}{2}}. \qquad - \qquad - \qquad (38)$$

which, in (22), gives

$$s = \pm (-[u' + 2p \pm 2\, u'^{-\frac{1}{2}} q])^{\frac{1}{2}}\, 2^{-1}. \qquad - \qquad (39)$$

But from (20) $z = s + t$. Hence, the four roots of z are,

$$z = 2^{-1} (u'^{\frac{1}{2}} + [-(u' + 2p + 2\, q\, u'^{-\frac{1}{2}})]^{\frac{1}{2}}). \qquad - \qquad (40)$$

$$z = 2^{-1} (u'^{\frac{1}{2}} - [-(u' + 2p + 2\, q\, u'^{-\frac{1}{2}})]^{\frac{1}{2}}). \qquad - \qquad (41)$$

$$z = -2^{-1} (u'^{\frac{1}{2}} - [-(u' + 2p - 2\, q\, u'^{-\frac{1}{2}})]^{\frac{1}{2}}). \qquad - \qquad (42)$$

$$z = -2^{-1} (u'^{\frac{1}{2}} + [-(u' + 2p - 2\, q\, u'^{-\frac{1}{2}})]^{\frac{1}{2}}). \qquad - \qquad (43)$$

Subtracting $4^{-1} b$ from each of these results, the four roots of (17) are obtained.

The formulas last obtained are of so complicated a character, at least

in appearance, that the merely practical engineer may be deterred from using them. How may the process for finding x and y be simplified? It is evident that the available roots of (17) must be real and positive. Find, then, the limits of the real and positive roots of (17), by trial or otherwise, and, by some method of approximation, determine the roots to at least four places of decimals, if they are fractional.

Or proceed thus, in (13) put $y = mc$, where m is fractional. There results,

$$x = a^{-1} c(c + bm - 2cm^2) = nc. \qquad - \qquad (44)$$

Substituting this value of x in (2),

$$y = \pm c(1 - n^2)^{\frac{1}{2}} = m'c. \qquad - \qquad - \qquad (45)$$

$$x = a^{-1} c(c + bm' - 2cm'^2) = n'c. \qquad - \qquad (46)$$

$$y = \pm c(1 - n'^2)^{\frac{1}{2}} = m''c. \qquad - \qquad - \qquad (47)$$

$$x = a^{-1} c(c + bm'' - 2cm''^2) = n''c. \qquad - \qquad (48)$$

&c., &c., &c., until x and y are obtained to four places of decimals.

The solution of the problem in this form is more difficult than in the first. Having found x and y, the length of the brace becomes known, for

$$l = [(b - y)^2 + (a - x)^2]^{\frac{1}{2}}. \qquad - \qquad - \qquad (49)$$

The simplest case is when the axis of the brace passes through the points A and D. The triangles A C D, and efg, are then similar, and from them we get the proportion,

$ef : fg :: \mathrm{AC} : \mathrm{CD}$, or, $x : y :: d'' : d'$, and

$$x = a'^{-1} d'' y. \qquad - \qquad - \qquad - \qquad (50)$$

(50) combined with (2) gives

$$y = \pm c(a'^{-2} d''^2 + 1)^{-\frac{1}{2}}. \qquad - \qquad - \qquad (51)$$

(51) in (50) gives

$$p = \pm a'^{-1} d'' c (a'^{-2} d''^2 + 1)^{-\frac{1}{2}}. \qquad - \qquad (52)$$

l is found by (10) or (49), according as $a\ a'$ 7 or $= 0$.

From this discussion, it is seen that for simplicity, $a\ a'$ should be 70, and that the axis of the brace should pass through A and D. Some difficulty may be occasioned by making both of these assumptions at the same time, but this may generally be avoided by giving suitable values to e and c'. When $a\ a'$ 70, it will be well to make $c' = c$ or $7\,c$. The value of e is dependent, in a measure, upon the diameter of the tie-rods connecting the upper and lower strings, and which pass through the blocks.

If $a\ a' = 0$, and x and y be assumed, the width of the brace will have to be found.

I owe an apology, perhaps, for rejecting, in this discussion, the ordinary form of fractional expressions, except in the case of exponents, and the radical sign. My reason for so doing is, that I find certain advantages to accompany this method of notation. I cannot, with propriety, point out these advantages now, as it would be foreign to my purpose. The use of fractional exponents to express the extraction of roots, is very frequent now, and I see no reason why this notation should not be adopted to the entire exclusion of the radical sign.

AMERICAN PATENTS.

List of American Patents which issued from March 6th, to April 3d, 1855, *(inclusive,) with Exemplifications.*

MARCH 6.

1. For an *Improvement in Machines for Cleaning Sisal Hemp, and Stripping Seeds from Broom Corn;* George D. Allen, Key West, Florida.

Claim.—"The combination of the prongs with the spring levers, or their equivalents."

2. For an *Improvement in Life Boats;* John Allen, City of New York.

Claim.—"1st, A life boat composed of a frame and a flexible covering, and provided with inlet and outlet pipes and valves, so that when the flexible covering is closed up perfectly water tight, the action of the waves on said flexible covering, and the tossing about of the boat on the water, will keep up a constant pumping action, and thereby supply fresh air to and discharge vitiated air from the interior. 2d, The construction of the frame of the two tubes, and right and left hand screw, and the longitudinal ribs."

3. For an *Improvement in Cook Stoves;* J. J. Anderson, Beaver, Pennsylvania.

Claim.—"The construction of the ellipsoidal oven in stoves, arranged in contact at the front with the horizontally corrugated fire brick and detachable ash-box."

4. For an *Improved Arrangement of the Springs on Wagons;* Harman W. Ballard, Burlington, Vermont.

Claim.—"The arrangement of the springs on either or both sides of the rocker, bolster, or axle-tree of a wagon, cart, or other vehicle.

5. For an *Improvement in Guards for Door Locks;* William Ballauf and Frederick Wurth, Cincinnati, Ohio.

Claim.—"1st, The bit or case, and the bracket adapted to the slot of an ordinary key hole, in combination with the cylindrical socket and tapering screw threaded spindle, adapted to the eye of the key hole, and which spindle, by means of a suitable key, can be screwed within or unscrewed from the key hole, the rotation of the screw by any other than the proper key being prevented by the described tumblers, or their equivalents. 2d, The sliding and vibrating tumbler or tumblers, provided with a locking dent or lug, catching within a notch in the spindle shank, and disengaged therefrom by the combined agencies of the channeled and sliding key, elevating pin or piston, longitudinal and T slots, and stationary pins, the tumbler, on the withdrawal of the key, re-locking by means of a suitable spring. 3d, In combination with tumblers, the longitudinal notches extending on both sides of a transverse or eccentric channel around the spindle shank. 4th, The eccentric and parallel channel around the spindle shank and key stem, acting simultaneously upon both dent and spur of each tumbler. 5th, The tapering screw threaded and spirally scored spindle in this connexion."

6. For a *Safe Catch for Breast Pins;* E. C. Benyaurd, Philadelphia, Pennsylvania.

Claim.—"The application and use of a safe catch, for the purpose of holding safely and securely the point end of the pin of breast pins, cuff pins, chatelaines, or any other piece of jewelry requiring a catch and pin."

7. For an *Improvement in Hand Cultivators;* Nehemiah B. Chase and Chauncy W. Saunders, Wilkinsonville, Massachusetts.

Claim.—"The arrangement of the knives upon the frame, so as to be adjustable in an oblique direction, and also reversible."

8. For an *Improvement in Processes for Making Bread;* Chas. Crum, Hudson, N. Y.

Claim.—"The suffering the dough to pass into the acetous state, then reviving it by the working and breaking into it fresh dry unfermented flour, and the subsequent process of cutting, piercing, raising in the open air, and baking in an open oven or ovens freely ventilated, and I claim this invention in its application to wheat flour, or any other flour of which bread is made."

9. For an *Improvement in Treating Fish for Manure and Oil;* René Charles Demolon and Geo. Alex. Chs. Thurneyssen, Paris, France; patented in France, Jan. 13, 1851.

Claim.—"The reduction of fish, or the remains of fish, to a dry powder, for manure and other purposes."

10. For an *Improvement in Harness Saddle-Trees;* J. C. Dickey, Saratoga Springs, New York.

Claim.—"The shank piece or prolongation of the nut, for the purpose of enabling me to place the turrets higher up on the yoke where they properly belong, and to prevent the reins passing through them from being too much spread at that point, as they would be if the turrets were placed at the joint, which is limited in its position."

11. For a *Machine for Cutting Mitre and other Joints;* F. A. Gleason, Rome, N. Y.

Claim.—"1st, The rotary dove-tail groover, or its equivalent. 2d, The mitre saw, with the clearing knife fixed upon the same chuck, and concentric with the groover; also, the manner of fastening the saws. 3d, The tonguing stock, with its saw and bevel cutter, or their equivalent; also, the manner of attaching it to the head stock. 4th, The carriage, with its movable bed, which may be adjusted to any angle required."

12. For a *Direct Double Acting Hydraulic Steam Pump;* R. B. Gorsuch, City of N.Y.

Claim.—"Effecting a water pressure upon the suction end of the pump plunger, in direct acting steam pumps, at or near the completion of the stroke, without diminishing the resistance against the forcing end of the plunger, in the manner as herein shown, or in an equivalent way, for the purpose of closing the suction valves, filling the vacuous space in the pump chamber, preparing the force valves for opening and acting conjointly with the steam pressure upon the piston, whereby the steam valve is operated with precision, whatever may be its velocity."

13. For an *Improved Auger Handle Fastening;* G. H. Hubbard, Shelburne Falls, Mass.

Claim.—"The ring."

14. For an *Improvement in Soda Water Apparatus;* M. F. Hyde, Burlington, N. J.

Claim.—"The porous distributor, or its equivalent."

15. For an *Improved Coal Screen;* George Martz, Pottsville, Pa.

Claim.—"The improvement by which the coarsest coal is separated from the finer sorts, and discharged at the mouth of the screen, whilst the finer sorts of coal are carried forwards and separated, the one from the other, in the usual manner."

16. For an *Improved Mill for Grinding and Bolting Sumac;* Samuel W. Powell, Tuscarora Valley, Pennsylvania.

Claim.—"The slotted hollow cylinder, having a shaft armed with spirally arranged teeth revolving within it."

17. For an *Improvement in Steering Apparatus;* Jesse Reed, Marshfield, Mass.

Claim.—"Combining with the divided nut, the adjustable guide and guard rails. Also, the supporting of the pedestals upon the stanchions, by means of long pins or studs passing through oblong slots in the pedestals, and into said stanchions, for the purpose of allowing the pedestals, and several parts connected therewith, to move fore or aft, up or down, to accommodate themselves to any rising or falling, or springing or bending of the rudder post."

18. For an *Improvement in the Combination of an Air Chamber, Water Cooler, and Force Pump, in Soda Fountains;* Newton D. Robins, Edinburgh, Indiana.

Claim.—"The apparatus, as constructed, of a combination of a water cooler, an air chamber placed within, and force pumps."

19. For an *Improvement in Railroad Car Coupling;* E. Rice, Canandaigua, N. York.

Claim.—"The arrangement of the movable guiding mouth, the catches, the inclined planes, the embracing band, and the lever, with each other and with the draft bar, in such a manner that the coupling bar will be self-caught, and retained when brought in contact with said parts, and by which it can also be readily liberated when the cars are in motion. In combination with the spring catches and the movable mouth of the coupling apparatus, I also claim the movable heads of the coupling bar."

20. For an *Improved Fire Place;* John W. Smith and J. S. Gallaher, Jr., Washington, District of Columbia.

Claim.—"The adjustable perforated blower pipe with perforated collar, as described, arranged with the detachable fire place, the latter having a perforated throat and double funnel ventilator, together with the valves, diaphragms, partitions, smoke conduit pipes, as constructed and arranged with the recess casings, forming air chambers and gas receiving apartments."

21. For an *Improvement in Machines for Making Candles;* J. Stainthorp, Buffalo, N. Y.

Claim.—"1st, The employment of the pistons, formed at their upper moulds for the tips of candles, in combination with stationary candle moulds, to throw out the candles in a vertical direction. 2d, The combination of the rack, tip bar, and clasps."

22. For an *Improvement in the Mode of Constructing Saw Plates, and Setting Teeth therein;* Linus Stewart, Washington, D. C.

Claim.—"The improved mode of constructing saw plate, and fastening of the bits therein; that is, the bits shall be so made and arranged with projections on each side equal to the set of the saw, and fastened therein with a key or other known modes of securing the same."

23. For an *Improvement in Machines for Stuffing Horse Collars;* W. L. Whittaker, Cumberland, Maryland.

Claim.—"In combination with the hoppers, the weighted racks for bringing down a regulated quantity of straw to take the place of that carried into the collars by the stuffing rods. Also, stuffing the collar simultaneously from both ends by means of stuffing rods which travel past each other at the centre of the collar, by which means the straw is evenly lapped at the centre as at the ends."

24. For an *Improved Arrangement of Exhaust Pipes in Locomotive Engines;* John Williams, Dunkirk, New York.

Claim.—"Surrounding the exhaust pipes with cylinders, the outer one connected by wings with the sides of the smoke arch, for the purpose of economizing fuel and power of the engine, as well as equalizing the draft through the lower flues of the boiler."

25. For an *Improved Mode of Extracting Stumps;* W. W. Willis, Orange, Mass.

Claim.—"The combination of the draft hook, shears, and pulley."

26. For an *Improvement in the Arrangement of Desks in School Rooms;* V. Woodcock, Swanzey, New Hampshire.

Claim.—"The diagonal arrangements of the seats and desks."

27. For an *Improvement in Apparatus for Purifying Illuminating Gas;* Dexter H. Chamberlain, West Roxbury, Assignor to Henry Woodward, Boston, Mass.

Claim.—"An improved gas purifying apparatus, the closed cistern, and made to distribute gas in contact with the liquid therein, and to be put in rotation by the gas, so as to stir up and agitate the said liquid, as specified; the said apparatus consisting of a wooden or other proper float, and a separate gas receiving and discharging apparatus, composed of the disk, the tube, and its receiving and discharging scroll, or the equivalent therefor; such a mode of constructing the agitator having important advantages over a simple float having an annular chamber formed within it, and made while resting on a purifying liquid to receive gas and to be raised by it, and so as to permit it to escape in numerous thin streams, and over in contact with the liquid."

28. For an *Improvement in Grain and Grass Harvesters;* John H. Manny, Rockford, Illinois, and Henry Marcellus, Amsterdam, New York.

Claim.—"Supporting the stalks of grass or grain to be cut, by means of rods or wires on one side of the sickle, while they are supported on the opposite side by means of the edges of the fingers in the usual way. Also, the construction of the shanks or near part of the fingers in such form that the shanks will pass or overlap each other, and mutually support each other and stiffen the finger bar. Also, the manner of connecting the rods to the fingers and to the cutter bar, and of adjusting them so as to support and brace the point of the finger with such degree of force as may be required."

MARCH 13.

29. For an *Improved Sash Fastener;* Wm. E. Arnold, Rochester, New York.

Claim.—"The arrangement of the bolt traversing in guides, the slide and the tumbler, in relation to the case, and the notches thereon."

30. For an *Improvement in Bottle Stopper Fastenings;* T. A. Ashburner, Phila., Pa.

Claim.—"The device herein described, for securing corks in bottles, viz: a button provided with hinged stirrups for catching under the projection of the bottle, for the purpose of more readily placing it on or removing it from the cork; and this I claim, whether said device is a fixture on the bottle, or separate therefrom."

31. For a *Polishing Apparatus for Watch Makers' Lathes;* J. M. Bottum, City of N. Y.

Claim.—"The application of the polishing spindle to the lathe, in such a manner that it has a universal movement, for the purpose of adjusting the polishing wheel to surfaces of various forms."

32. For *Improvements in Machines for Turning, Boring, and Slotting Metals;* Alanson Brown, Rochester, New York.

Claim.—"So arranging the table or face plate, and upper spindle or tool holder, on a machine for turning, boring, and cutting key seats, as that either one of the two may be revolved, and the other remain stationary, as the character of the work may require. Also, combining with the upper spindle a revolving slide head carrying a cutter susceptible of either a horizontal or vertical motion or adjustment, for the purpose of turning off work either inside or outside that will not revolve between the columns. Also, the arranging of the two, three, or more supporting columns, in rear of a plane drawn through the line of centres of the operative parts of the machine, for the purpose of leaving an unobstructed front for the introduction of the piece to be dressed."

33. For an *Improvement in Self-Loading Carts;* Ze Butt, Lincolnton, N. Carolina.

Claim.—"The manner of constructing, arranging, combining, and operating cart bodies, so that they can be dropped to or upon the ground to receive the load, be loaded as the cart moves forward, and then elevated, and dumped or unloaded the same as an ordinary cart."

34. For an *Improvement in Excluding Dirt from Grooved Railroad Rails;* C. M. Eakin, Philadelphia, Pennsylvania.

Claim.—"The application of an elastic filling to the groove which is formed in the track to receive the flanches of the wheels."

35. For an *Improvement in Hoop Jacks for Sailing Vessels;* E. Foster, Fairton, N. J.

Claim.—"The arrangement of the hoop jack with the lower halyard block, the brace line, clevis and gaft hook; clevis and hoop line extending down to the foot of the mast, and connected to each sail hoop."

36. For *Improvements in Cut-off Valves for Steam Engines;* Noble T. Greene, Bridgeport, Connecticut.

Claim.—"Combining with the rocking levers, or their equivalents for operating the valves, the spring tappets on the sliding bars. Also, in combination with the sliding spring tappets that operate the rock levers, the employment of the gauge bar, or any equivalent therefor, to regulate the period of closing the valves, whether the said gauge bar be regulated by a governor, or by other means."

37. For an *Improvement in Seed Planters;* H. Ludington and S. R. Lupton, Addison, Pennsylvania.

Claim.—"The construction of an expanding sectional hopper, hung by hinges, or otherwise pendent, and formed with concaves on the inner side, which concaves have formed thereon diagonally arranged ridges or sloping irregularities. Also, the construction of a drum, cylinder, or roller, with series of ridges or sloping irregularities formed or arranged diagonally across its circumference or periphery, together with longitudinal troughs or gutters, at intervals between the ridges; this cylinder being also combined in action or operation with the hopper and the revolving spike shaft. Also, constructing a feeding or supply fountain, having the combination of adjustable hinged frame grating, actuated by cords or equivalents, and to answer the two-fold purpose of holding the

compost mass, and preventing the escape of lumps, &c., &c., and admitting also of being elevated or depressed, or thrown forward at pleasure, for the purpose of relieving the grating and hopper or fountain of lumps and other obstructions."

38. For an *Improvement in Gas Regulators;* J. W. Hoard, Providence, R. Island.

Claim.—"The arrangement of the inverted cup, so that only the upper side or exterior is exposed to the pressure of the gas, and the under side or interior is exposed to the atmosphere, when this is combined with the application to the said cup of the air spring, or its equivalent."

39. For an *Improvement in Screw Wrenches;* Joseph Hyde, City of New York.

Claim.—"The auxiliary jaw or 'gripper,' applied to or inserted within either the stationary or movable jaw of a hand or screw wrench, said jaw or gripper being constructed and arranged as herein shown, or in an equivalent way, so as to bind or press the article between it and the stationary jaw, with a force proportionate to that exerted in turning the wrench."

40. For a *Machine for Making Paper Boxes;* Louis Koch, City of New York.

Claim.—"1st, The application of a series of rollers connected together and worked by an arrangement of levers and toes or cams, for the purpose of bringing paper from an endless roll and of a required length into the machine, and pieces of paper previously shaped and pasted by the machine to the place required. 2d, The application of a stamp frame with suitable knives or stamps attached, situated between the rollers, for the purpose of cutting off the paper the required size and shape from the endless roll necessary for one box. 3d, The application and construction of the pasting frame, with paste boxes situated between the rollers, and arranged in such a manner as to paste the already shaped paper in the required places. 4th, The construction and application of a wheel with arms, having at their extremity the moulds attached, around which the boxes are to be made, said wheel with moulds being moved by an arrangement of a rod and lever actuated by a cam. 5th, The application and use of a series of slides, for the purpose of folding the ends of the paper round the mould, said slides being worked by a combination of levers, &c., actuated by toes. 6th, The application and use of a pair of pincers, for the purpose of pulling the finished paper box off the mould. 7th, The construction of the outer mould, formed by two projections attached to the frames, and a hinge valve, and the operation and manner of working said valve."

41. For an *Improved Grain Cleaner;* George Leach, Owego, New York.

Claim.—"Dressing or furrowing the stones by having the furrows or grooves cut in the face of the bed stone, and the furrows or grooves in the face of the runner."

42. For an *Improvement in Sleighs;* Wm. W. Gruivits, Rodgersville, New York.

Claim.—"The combination of the sliding bolsters and friction rollers with the axletree and fixed bolsters. Also, the slots in the cross bar, which permit the movement of the forward runners without any wrenching."

43. For an *Improved Ditching Machine;* Robt. C. Mauck, Harrisonburg, Va.

Claim.—"The mode of regulating the operation of the cutter or plough, by means of the swinging frame connected with the body of the machine, in connexion with the check plates."

44. For *Improved Valves for Gas Burners;* Andrew Mayer, Philadelphia, Penna.

Claim.—"Fitting the valve cups to a tube which forms a valve box in which all the cups and valves can be properly fitted without difficulty, and inserted conveniently in their place in the burner, or into any chamber prepared to receive them."

45. For an *Improved Evaporating Apparatus;* James McCracken, Bloomfield, N. J.

Claim.—"The arrangement and use of a set of metallic cylinders containing vertical tubes, in connexion with the mode of conveying the escape steam from the pans to the condenser."

46. For a *Method of Operating Pumps by Wind;* H. Moore, Charleston, Michigan.

Claim.—"The combination of a compensating cam and spring, or the equivalent thereof, for operating a pump driven by a wind-mill."

47. For an *Improvement in Washing Machines;* Elijah Morgan, Morgantown, Va.

Claim.—"Suspending a reciprocating rubber between the yielding bar and wash board, in such manner that said wash board and bar may both have a vertical motion

during the action of the rubber, and at the same time an expansive action or motion due to an over accumulation of the clothes between the rubber and the wash board."

48. For an *Improvement in Fire Extinguishing Compositions;* Edward F. Overdeer, Chattanooga, Tennessee.

Claim.—"The employment of a solution of pearl ash in water, in the proportion of 16 pounds of pearl ash, or thereabout, to 100 gallons of water, as a substitute for water in extinguishing fires."

49. For an *Improvement in Lamps;* Frederick C. Rider, Providence, Rhode Island.

Claim.—"The use of the regulator tube, arranged and operated in combination with the wick and wick holder, as applied to the inner surface of the wick to regulate and control the flame of the wick."

50. For an *Improvement in Brick Kilns;* Jesse Russel, Elkton, Kentucky.

Claim.—"The arranging of the fire chambers outside of the kiln, and introducing the products of combustion to the brick to be burnt through avenues or passages extending from the fire chambers entirely across the kiln, when said fires are placed and used on one side of the kiln only."

51. For an *Improvement in Ordnance;* Christopher Wolter, Bridgeport, Conn.

Claim.—"1st, The connexion of two barrels or pieces, mounted in such a manner that they may be adjusted and held at any desirable angle relatively to each other. 2d, The connexion of the barrels by means of the toggle joints, and the central slider working in a suitable slide supported by the carriage, for the purpose of adjusting the barrels at the desired angle. 3d, Supporting the breeches for the purpose of varying the elevation of the barrels by means of a frame composed of sectors, and slotted heads attached thereto, as described, whereby the necessary changes of elevation, and of the angle of the two barrels are provided for, independently of each other; this I claim, irrespective of any mechanical devices that may be employed to raise and lower the frame. 4th, The connexion of the two hammers or the triggers, or their equivalents, by means of two links with a sliding piece, operated upon by a cord or chain connected with a rod which passes through the side of the carriage and has a spring applied. 5th, Connecting the cord or chain with the rod, or its equivalent, by merely passing it through an eye at the end thereof, and attaching it to a winch conveniently situated, to keep it always wound up to the proper degree to give it the required length."

52. For an *Improved Safety Ferry Bridge;* Henry Lawrence, City of New York.

Claim.—"The employment of the reciprocating carriage, the suspended central gate, and side gates, the whole being operated by the boat and weights. Also, making the side gates of a circular form instead of flat, so that in case drunken or thoughtless men lay hold of them, or get in a position to interfere with their being opened freely, they shall, as they open, have a tendency to throw them off, instead of forcing them up against the railings and crushing them."

53. For an *Improvement in Curtain Rollers;* Frederick W. Urann, Saxonville, Mass.

Claim.—"The improvement of extending the pulley head into the bracket, for the purpose of protecting the cord of the pulley from getting between the said head and the bracket during the process of rolling up or unrolling the curtain."

54. For an *Improvement in Stump Machines;* Edward Vaughn, Alliance, Ohio.

Claim.—"The arch beams. The brace posts, in combination with the incline braces and horizontal beams, making a new and useful, firm, and compact frame. Also, the combination of a half sphere and groove, forming a new half spherical washer. Also, the combination of the groove opening with a square recess. Also, for the purpose of attaching and detaching the trucks to and from sills, by the combination of levers, fulcrums, joints, posts, dogs, and levers. Also, the securing of the bar to the hounds. I do not claim any one separate thing in the above mentioned invention, but do claim the combinations."

55. For an *Improvement in Door Locks;* Wm. Warwick, Birmingham, Pa.

Claim.—"The so forming of the tumblers with beveled edges for the key to operate it, and so arranging it in relation to the bolt and the stud, that when locked the bolt is held firm against pressure, by the tumbler fitting over the stud."

56. For an *Improvement in Eaves Gutters of Houses;* George W. Wheatly, Harrodsburgh, Kentucky.

Claim.—"The application of a bead or moulding, together with a strop, to gutters, giving strength to the gutter without the aid of a plank, or other substance."

57. For an *Improvement in Breech Loading Fire Arms;* R. White, Hartford, Conn.

Claim.—"The connexion of the breech with the hammer, in such a manner that it may be withdrawn to open the chamber to receive the charge by the act of cocking the hammer, and replaced to close the chamber by the falling of the hammer when the latter is set free to explode the charge."

58. For an *Improvement in Breech Loading Fire-Arms;* R. White, Hartford, Conn.

Claim.—"1st, The connexion of the breech or breech-piece with the hammer, in such a manner that the latter may be cocked by the act of moving the former into its place to close the chamber. 2d, The peculiar manner of effecting the cocking and setting free of the hammer by means of the spring tooth attached to the breech or breech piece, and the sliding piece working in the tumbler to be acted upon by the trigger, for the purpose of disengaging the said tooth. 3d, The employment of a crank or eccentric, for the purpose of disengaging the tooth from the tumbler, and thereby disconnecting the hammer from the breech or breech-piece, when the immediate repetition of the discharge is not desired."

59. For an *Improvement in Processes of Curing Meats;* J. C. Schooley, Cincinnati, O.

Claim.—"The process of curing meat and preserving fruit and provisions by means of circulating currents of air artificially dried by ice, or its equivalent, through the room wherein the curing takes place."

60. For an *Improvement in the Manufacture of Stone Paste Boards;* James Smith, Mendon, New York.

Claim.—"Sheets for roofing, boarding, and other purposes, made or constructed by combining said stone, when pulverized, with paper pulp, and I also claim the application of and combining drying oil with said pulverized stone and paper pulp combined in sheets, as aforesaid."

61. For an *Improvement in Machinery for Spinning Wool;* Frederick S. Stoddard, Litchfield, Connecticut.

Claim.—"1st, Conducting the roving from the back to the front drawing roller, by employing a bridge or rest, with fingers upon it, situated between the front and back pairs of drawing rollers, for the purpose of governing the counter twist so as to adapt a smaller portion of it to the part of the thread nearest the back rollers. 2d, Impeding the ring travelers while winding upon the lower or larger parts of the cones, by means of a series of brushes, or their equivalents, operating substantially as set forth, so as to gradually set the travelers free as the winding approaches the smaller or upper ends of the cones, thereby producing a uniform tension on the thread while winding."

62. For an *Improvement in Air-Heating Furnace;* James H. Sutton, Honesdale, Pa.

Claim.—"The arrangement of the furnaces, the descending smoke pipes, and the central smoke pipe, with each other and with the single air heating chamber."

63. For an *Improved Apparatus for Operating Ventilators;* Isaac P. Trimble, Livingston, New York.

Claim.—"Having the valves or ventilating doors connected to the said metal bands, about midway between their fixed supports, so that the varying degrees of flexure shall effect the operation of opening or closing said doors."

64. For an *Improvement in Benzole Vapor Apparatus;* Chas. Cunningham, Nashua, New Hampshire, Assignor to John C. Pedrick, Boston, Massachusetts.

Claim.—"1st, The combination of the heater and the swinging gas burner, or of the induction air pipe and any one of the burners of the apparatus, with the water vessel, the reservoir, or the metre, for the purpose of keeping the contents of the vessel containing the benzole or light producing liquid, at a given temperature. 2d, The combination of the reservoir and the rotary disseminator with an ordinary rotary metre wheel, for forcing air through the hollow shaft, or its equivalent, into the reservoir, for the purpose of vaporizing the benzole of the latter vessel. 3d, The particular mode of making the

rotary disseminator. 4th, The application and use of the metre with its case and contents, as an air blast apparatus, operated by weights or otherwise."

65. For an *Improvement in Cultivators;* Sam. A. Knox, Assignor to Ruggles, Nourse, Mason & Co., Worcester, Massachusetts.

Claim.—"Arranging the curved knife or pointed tooth at or near the front end of the beam of the horse hoe, while the main or double hoe is disposed at or near the rear end of the beam, and so as to enable the said tooth to be used in manner and for the purposes as stated, it being employed in a common plough simply for cutting the sod or opening it for the reception of the nose of the plough."

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66. For an *Improvement in Folding Life Boats;* Edward L. Berthon, Fareham, England; patented in England, June 12th, 1851.

Claim.—"Hinging longitudinal ribs of the two sides to the stem and the stern posts, in such manner that those ribs shall be capable of being folded down, and shall lie parallel with the keel when the boat is collapsed."

67. For an *Improved Swivel for Watch Chains;* Elihu Bliss, Newark, N. Jersey.

Claim.—"The specific arrangement of the joint of the swivel."

68. For an *Improved Wagon Brake;* J. E. Blodgett, Oswego, New York.

Claim.—"The application of wagon brakes to the forward wheels of wagons, by using the hounds, sway-bar, block tongue, or other appendages running back from, and firmly attached to the front axle, as the frame for the support and steadying of such brakes; also, the construction of a brake so light and simple as to admit of being supported by such frame, such brake having a main bar of sufficient length to receive both pads, said main bar turning upon its fastening at or near its centre, with the pad for one wheel firmly attached to one end, and the pad for the other wheel so attached to the other end of the main bar as to turn on such attachment or fastening, such turning pad to be of such form as to bear against its wheel on being turned partly round, and to bear harder on being turned further, and at the same time, by crowding back that end of the main bar to which it is attached, to throw the other end with its pad against the other wheel."

69. For an *Improvement in Knobs for Fastening Curtains, and other like Purposes;* W. Z., W., and J. W. Chapman, City of New York.

Claim.—"The combination of the eyelet, or its equivalent, with a shank or knob of metal, or other material that is covered, capped, encircled, or so connected with india rubber, or the equivalent thereof, that by its elastic nature the said eyelet may be secured to it."

70. For a *Method of Self-Ventilation for Railroad Cars;* V. P. Corbett, Corbettsville, New York.

Claim.—"Forming a series of ventilating holes in the sides of the car between the ceiling and windows, and providing in said holes vertical ventilating fans, which are arranged so as to be caused to revolve by the rapid moving of the car through the atmosphere, and thus made to exhaust the impure air from the inside of the car."

71. For a *Device for Air Chamber Pumps;* John P. Cowing, Seneca Falls, N. York.

Claim.—"The combination and arrangement with the air chamber or vessel of the pump, having its delivery spout or outlet below, or at or near the bottom of said chamber, of a hand air valve or perforated nut at or near the top of the air vessel, for the conversion by hand with facility and despatch, of the close air vessel into an open water reservoir, or vice versa, above the discharge outlet or spout, and whereby the uses of the common well or lift pump may be varied with despatch, and its convenience augmented."

72. For a *Machine for Cutting Barrel Heads;* A. H. Crozier, Oswego, New York.

Claim.—"1st, Arranging and operating two rotating cutters so as to cut scores in the opposite sides of the rotated heading at the same time, one cutter being arranged and operated so far in advance of the other that the latter cutter may cut so far into the heading and into the score made by the former without interfering with it, (the first cutter,) as to sever the superfluous portions of the heading from the head, at the same

time that they cut it circular, and bevel or form the edge to fit the croze in the cask. 2d, Traversing or vibrating the clamp edgewise, after the heading is placed in it, to bring the heading in contact with the cutters, and to remove the head from the cutters after it is formed, so as to take it out of the clamp, and insert material to form another head and bring it into contact with the cutters without stopping them (the cutters,) during the operation or time occupied in making the change. 3d, The revolving clamp, in combination with the rotating cutters."

73. For a *Pump;* Charles G. Curtis, Springfield, Massachusetts.

Claim.—"Arranging the eduction and induction valve chambers concentrically around the upper end of the pump barrel, and with respect to one another, they being provided with valves and passages connecting them together, and with the two ends of the pump barrel, the said arrangement admitting one cap plate to be employed both for the valve case and the pump barrel, and at the upper end of said pump barrel."

74. For an *Improved Shot Cartridge;* Abbot R. Davis, East Cambridge, Mass.

Claim.—"An improved shot cartridge, made by mixing the shot in a plastic material or compound, subsequently reducing the mass to the shape required for the cartridge, and covering its external surface with fibres of wool or other material, felted or applied thereto."

75. For an *Improvement in Feeding Fuel to Furnaces;* H. Delano, Syracuse, N. Y.

Claim.—"The combined use of the feed box and grate bars or cut-off, for feeding in fuel into the under part of the burning mass in the fire box, or their mechanical equivalents. Also, the combination of the crank shaft, slotted piece, lever, and trigger, or their mechanical equivalents, for sliding the feed box and grate and cut-off, and for raising and lowering the bottom of the feed box."

76. For an *Improvement in Rakes and Elevators;* Alexander H. Gaston and Joseph Smith, Sunbury, Ohio.

Claim.—"The endless belts and rakes, in combination with the rollers and revolving forks, for the purpose of raking and loading hay."

77. For an *Improvement in Extension Tables;* Joel Haines, West Middlebury, Ohio.

Claim.—"The construction and arrangement of the top so as to wind up in the case."

78. For a *Valve for Hydraulic Rams;* Thomas Hanson, City of New York.

Claim.—"The mode of forming the connexion between the driving chambers and air vessels of water rams, the tube and flexible cup placed within it."

79. For an *Improvement in Lamps;* Elbridge Harris, Boston, Massachusetts.

Claim.—"Using within glass lamps of any form, reservoirs of metal which are provided with the usual tubes for burning common oils, or adapted by means of protectors to burn any fluid combustible. Also, the mode of ornamenting such reservoirs contained within glass, by means of paper with metal or ornamental surfaces."

80. For *Ship Augers, &c.;* Isaac W. Hoagland, Jersey City, New Jersey.

Claim.—"Attaching the cutting portion of the auger to the screw portion, as herein shown and described, viz: by means of the dove-tail notch formed by the shoulder and inclined end, dowel, and screw."

81. For an *Improvement in Railroad Car Brakes;* Gideon Hotchkiss, Windsor, N. Y.

Claim.—"The method of operating a railroad car brake by obtaining leverage from the axles and boxes by means of the bridges, keys, and clutches, or their equivalents."

82. For an *Improved Hand Press for Printing;* Chas. Keniston, Boston, Mass.

Claim.—"The arrangement and construction of the press, as herein described; that is to say, there is an extended arm on which a piston and type are attached, the same operating upon a swivel, the whole being attached to a solid bed. There are two pads attached to said bed, one for the purpose of inking the type, the other for the article to be placed on when printing. The operator, by turning said arm over the pads, and striking a light blow upon the top of the piston, alternately will ink and print with the accuracy that no other press has done."

83. For an *Improvement in Seed Planters;* Ebenezer Morse, Walpole, N. Hampshire.

Claim.—"The scrapers, the cam and sliding back board, as arranged, combined, and operating conjointly with the seed box, for the purpose of depositing seed in hills, covering it with earth, and pressing the earth upon the seed. Also, the oscillating motion of the horizontal handle, connected to the front and back part of the seed box by a hinge joint at each end of the handle."

84. For an *Improvement in Fire Arms;* Frederick Newbury, Albany, New York.

Claim.—"The ratchet plate with its ratchet indentations and its slot, in combination with the pin by which it connects the cylinder. Also, the two stop levers below the cylinder to regulate and secure the connexion between the chambers of the cylinder and the barrel. Also, the arrangement and combination of the tumbler with the hammer and cocking spring, to enable the hammer to act independently of the tumbler in the act of firing. Also, the arrangement of the hammer to lie within the stock, and to act in such line of direction upon the nipple as to press and hold the cylinder firmly against the barrel in the act of firing. Also, the arrangements of the apparatus for disengaging and attaching the barrel with the cylinder to the stock, viz: the thumb connecting plate or detent, with the spring to hold it in place, and the notch in the mandrel to receive the detent."

85. For an *Improvement in Cartridges;* Abner N. Newton, Richmond, Indiana.

Claim.—"The arrangement of the percussion priming with a metallic rod, whereby said priming is ignited within the chamber of the gun between the ends of two metallic rods."

86. For an *Improvement in Seed Planters;* Daniel H. Phillips, Greenville, Illinois.

Claim.—"1st, The employment of a spring lever to open and close the seed slide in such a manner that while it serves to open the slide by the direct action of the revolving wheel or roller, as specified, the same lever, by its elasticity, closes the slide after the discharge has been made. 2d, Providing both ends of the carrying and leveling roller which operates the seed slide lever, with cogs or projections, so arranged that by reversing the roller, as described, a slower or quicker movement is given to the delivery slide, according to the description of grain to be planted."

87. For an *Improvement in the Manufacture of Bricks;* L. E. Ransom, Havana, O.

Claim.—"The manufacture of bricks by first spreading the tempered mortar or clay at once upon the ground where the bricks will be left to dry, and in beds of certain desired length, width, and thickness, and then while the mortar is in a soft state, or before it shall crack by too much drying, producing therein lines of weakening or separation, defining the dimensions of the bricks without regard to their smoothness or final finish, and after the bricks in drying shall have separated from each other along the lines thus formed, turning them on edge, and squaring and polishing their edges, and defining the thickness of the same by rubbing over them the metallic tool, or otherwise, the desired thickness of the bed being produced by means of guide bars or moulds, and scraper or lute, whereby I am enabled to dispense with off-bearers, and otherwise to simplify the manufacture of bricks."

88. For an *Improvement in Mowing Machines;* Fisk Russell, Boston, Massachusetts,

Claim.—"Arranging the secondary supporting wheel and the cutter frame in front of the driving shaft, when such driving shaft and the driving wheel are arranged and connected by gears, as specified, the same serving to lessen the side draft or pressure on the horses or draft animals, in comparison to what it would be were the secondary wheel and the cutter frame disposed back of the driving shaft, when arranged with respect to the driving wheel. Also, the combination of two knives so that they shall project in opposite directions from one centre plate or bar, in order that either of the knives may be used in connexion with the guard teeth, and either be made to serve as a lever to the other, whenever circumstances may require."

89. For a *Machine for Polishing Daguerreotype Plates;* D. Shive, Philadelphia, Pa.

Claim.—"The shaft with its arms, cranks, the pieces C and D, or their equivalents, and the eccentric, with its spur wheel, in combination with the united spur wheels."

90. For an *Improvement in Seed Planters;* Benj. M. Snell, Hancock, Maryland.

Claim.—"The construction of a plough, wherein a double share is used to open the

soil, in combination with a seeding tube, hopper, and striker of wheel, for the purpose of depositing seed in the prepared soil, without the objection of an open furrow."

91. For an *Improved Self-Loading Cart;* J. A. Sprague and B. O'Connor, Dayton, O.

Claim.—"1st, The combination of a large divided scoop with an ordinary cart. 2d, The angle irons on the under side of the cart shafts near the forward ends."

92. For a *Mortising and Tenoning Machine;* Elihu Street, Montville, Connecticut.

Claim.—"The improvement on a machine for mortising, tenoning, sawing, and smoothing, by combining certain tools together, used by carpenters, in the manufacture of doors, sash, and blinds."

93. For *Improvements in Valve Gearing for Steam Engines;* H. Uhry and H. A. Luttgens, Paterson, New Jersey.

Claim.—"The differential rocker, in connexion with the stationary or shifting link motion, for the purposes of increasing the opening of the steam ports at the higher grades of expansion, and retarding and varying the time of exhaust without incurring early compression attending increase of inside lap on an ordinary valve. Also, the duplicate valve seats, being arranged parallel to each other, provided with steam ports and an exhaust port; the two steam ports towards the front of the cylinder joining in one passage, lead the steam to that end of the cylinder, the other two steam ports leading the steam into one passage towards the back end of the cylinder."

94. For an *Improvement in Looms;* Lewis Van Riper, Spring Valley, New York.

Claim.—"1st, Intertwining the warp threads in the manufacture of gauze fabrics, by the employment of needles having a compound motion. 2d, Constructing the needles for working the warps with flat, or thin and crooked ends. 3d, The arrangement of the needles in two series, and giving to one or both series a compound lateral and longitudinal motion, to intertwist the threads which the two carry, and at the same time open a shed for the insertion of the weft thread. 4th, The method of working the needles so as to cause them to raise and lower and intertwine the warps alternately, with simply raising and lowering them, to adapt them to weaving gauze and plain fabrics alternately. 5th, The combination of the needles and heddles operating automatically, so as to form a web of reticulated bars or strips of plain fabric with the spaces between the bars or strips filled with wire gauze. 6th, The combination of the yielding reed, the lever, with the pin on its lower end, the pin on the sword of the lay, the ratchet lever, with its double inclined planes, for the pin to act upon, and the ratchet wheel with the cloth beam, for the purpose of winding up the woven fabric at a variable rate. 7th, The combination of the mechanism for winding up the woven cloth with the cam, and the intermediate devices, for the purpose of effecting the requisite changes in the variable cam. 8th, The variable cam, for the purpose of changing the operation of the needles to adapt them to weaving plain and gauze fabric alternately."

95. For *Pumps;* William T. Vose, Newtonville, Massachusetts.

Claim.—"Connecting the two pump barrels at two adjacent ends, in combination with not only arranging the valves of their respective pistons so that one of them shall be applied to one or the upper side of one piston, while the other is applied to the opposite or lower side of the other piston, as stated, but applying the eduction and induction pipes respectively to the disconnected ends of the barrels."

96. For an *Improvement in Breech Loading Fire Arms;* Alex'r. T. Watson, Castleton, New Jersey.

Claim.—"The mechanical combination and arrangement of the cylinder, the bent lever, and the forked standard, acted upon by the rod and spiral spring; also, the spring, by which, being drawn back, the cartridge is released from the pressure, and the cylinder is made to pass over the next succeeding cartridge, and the pressure of the finger being removed from the rod, the cartridge is firmly griped and carried forward towards the chamber by the action of the rod and spring, pushing before it also the next preceding cartridge ready to be deposited in the chamber upon the raising of the breech piece, which operation being repeated after each discharge, in connexion with raising the breech piece, secures a measured supply of charges from the magazine in the stock to the chamber, to an extent and with a facility not heretofore attained in breech loading fire arms. Also, the forming of the breech piece of a segment of a circle, having the concave space for the bottom of the chamber with its central point of depression in the

line of the axis of the barrel. Also, the forming the lower end of the breech piece into two cutters, one front, the other back, with the rounded swell between, operating as well to hold the cartridge in its place as to cut off the end, and remove the parts thus cut off."

97. For an *Improved Printing Press;* Lemuel T. Wells, Cincinnati, Ohio.

Claim.—"The platen, hinged or pivoted to vibrating arms, in combination with the stationary pin or pins, and retracting springs, or equivalent devices."

98. For *Centrifugal Water Wheels;* Oscar Willis, Dizardville, North Carolina.

Claim.—"1st, The peculiar double curved buckets, in combination with the beveled rim and hub, (or nut.) 2d, Ranging the top of the bucket on a line tangential to a circle of suitable diameter described around the centre, its inner being in advance of the radial line. 3d, Forming the annular water space on the upper side of the wheel."

99. For an *Improvement in Grain and Grass Harvesters;* Walter A. Wood, Hoosick Falls, New York.

Claim.—"Making the inner face of the supporting wheel conical, for the purpose of clearing the track for the next or return swath of the machine. Also, the forming of a quadrangular space on the platform between the end of the cutting point and the frame of the machine, sufficient to hold as much grain as will make a bundle or sheaf, before it is raked from the machine."

100. For an *Improvement in Cultivators;* Geo. W. N. Yost, Port Gibson, Miss.

Claim.—"The combination of the adjustable scraper with the bar, point, &c., for the purpose of baring off the row and rapping up the middle; also, for scraping off the row and rolling the scrapings over into the furrow opened by the plough."

101. For an *Improvement in the Arrangement of Wheels, Axles, and Friction Rollers;* George A. Prentiss, Cheshire County, New Hampshire.

Claim.—"The combination of the following elements, viz: a load axle with a bearer secured thereto, a securing axle, concentric therewith, or nearly so, and a ring or series of friction rollers, the whole being applied to a pair of wheels."

102. For an *Improvement in Sewing Machines;* Geo. W. Stedman, Vienna, N. J.

Claim.—"Feeding the cloth along by means of the needle acting as a lever against it over a fulcrum, the needle carrier being driven for the purpose with a crank motion, or its equivalent. Also, regulating the length of the stitch by the combined action of the slot, of adjustable length, and the slight spring, or its equivalent, for throwing the needle away from the fulcrum when disengaged from the cloth. Also, the construction of the finger with a thin pointed beak for entering the loop, with a wedge-shaped shoulder for spreading the loop open to receive the needle in turn, and with a spring for retarding the motion of the loop, arranged and operating in combination with the needle."

103. For an *Improved Press for Making Cylindro-Conical Hollow Projectiles by Pressure;* Wm. M. B. Hartley, City of New York.

Claim.—"The collar, in combination with the sectional parts of the die. Also, the arrangement, relative to the punches, of the die, with a horizontal motion of sufficient amplitude to admit of the successive action of the punches. Further, the ball while in its die, and while held firmly at its base by a punch, which punch, on the opening of the sections, will, by a subsequent or continuous motion, discharge the ball capped and ready for use."

104. For an *Improvement in Attaching Augers to Handles;* Chas. W. Cotton, Shelburne Falls, Massachusetts.

Claim.—"Attaching or securing augers to handles, by having a metallic tube placed around the centre of the handle, and having a transverse rectangular taper hole made through the handle and tube, and a metallic band placed around the tube, and turning loosely thereon, said band having slots made through it, a part of the slot being of taper form. The shank of the auger being placed in the hole and through the slots in the band, and secured in the handle by turning said band and causing the edges of the taper portion of the slot to pass in the notches or recesses in the shank."

105. For an *Improvement in Ore Separators;* Reuben Shaler, Madison, Connecticut.

Claim.—"The combination of mechanism which separates the fine earth and small particles of gold from the coarse, and exposes the finer portion of impurities and gold to

a moderate blast, and the coarser portion to a more powerful blast. The said combination embraces the blower, which produces two blasts of unequal force, the two sets of shelves or inclined planes, and the screen, or its equivalent."

106. For an *Improvement in Sewing Machines;* Thomas J. W. Robertson, Assignor to self and Alfred E. Beach, City of New York.

Claim.—"The combination of the spring clamp with the feeding bar or dog, constructed, arranged, and operating together against the cloth, on its one side or surface."

107. For an *Improvement in Casters for Furniture;* Gilbert L. Bailey, Assignor to self and Mighill Nutting, Portland, Maine.

Claim.—"The pin or oval guide put through or applied to the spindle in any manner, or its equivalent, and attached to a straight truck frame, with a socket hole larger than the spindle."

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108. For a *Rotary Pump;* Abel Barker, Honesdale, Pennsylvania.

Claim.—"Causing the buckets, during a portion of their revolution, to pass through an inclosed channel, and, during the remainder of their revolution, to pass through the chamber which communicates directly with the central induction opening."

109. For a *Clamp and Mouth-Piece for Lumber Jointing Machines;* Chas. F. Bauersfeld, Cincinnati, Ohio.

Claim.—"1st, Two or more clamps, so arranged and connected as to be simultaneously and equally applied to or withdrawn from the different parts of a portion of furniture to be jointed, by the means of a single handle. 2d, The parallel motion, fixed in any desired position by means of the bridle and screw."

110. For an *Improvement in Preparing Woolen Roving;* Augustus E. Bigelow, Chicopee, Massachusetts.

Claim.—"The mode of operation of spinning woolen yarns from previously twisted rovings, by drawing the twisted roving between two sets of draw rollers, in combination with the subsequent twisting in the same direction by ring groove travelers, flyers, or other equivalent devices."

111. For an *Improvement in Spinning Wool;* Augustus E. Bigelow, Chicopee, Mass.

Claim.—"The combination of flyers, or the equivalents thereof, and their appendages, with the ring doffer or doffers of a carding machine, by the interposition of a pair or pairs of rollers, to deliver the slivers from the doffer or doffers, that they may be regularly twisted and wound on without drawing."

112. For an *Improvement in Machines for Turning the Lips of Augers;* Ransom Cook, Shelburne Falls, Massachusetts.

Claim.—"The combination of the screw shaft, or its equivalent, with the wrench, and crimping or clamping dies. Also, the shape of the wrench, for the purpose of turning the lips of boring implements."

113. For *Improvements in Grain and Grass Harvesters;* Andrew Dietz and John G. Dunham, Raritan, New Jersey; ante-dated January 2, 1855.

Claim.—"1st, Constructing the cams upon the driving wheel of a length exactly corresponding to the cutting range of a single stroke of the knife during the advance and return of the cutter bar. 2d, The difference in the relative depths of the cams, in combination with the linked levers. 3d, Arranging the highest elevation of each cam upon the wheel at a point between the highest elevation and lowest depression of a cam upon the other side of the wheel."

114. For an *Improvement in Processes for Refining Jewelers' Scraps;* L. B. Darling, Providence, Rhode Island.

Claim.—"The processes of separating and recovering the gold and silver from goldsmith's and jeweler's scraps, such as turning, sweepings, cuttings, and filings, which contain both noble and base metal, that is, by melting down the metallic compounds, then stirring in gradually the nitre, and working the mass without fluxing, then washing with water and treating with sulphuric acid to convert the oxydized products into sulphates."

115. For an *Improvement in the Combination of Speed and Resistance Governors;* William H. Elliot, Plattsburgh, New York.

Claim.—"The combination of a speed governor with a resistance governor, in such a manner that each shall exert its own proper effect upon the motive power, producing thereby a compound resultant regulation, without either of the said governors interfering with the action of the other."

116. For an *Improvement in Chairs;* Lemuel W. Ferris, Owego, New York.

Claim.—"Hinging the seat, at its back, to the back of the chair, only in combination with hinging the rails of the foot rest to the lower end of the pieces forming the back, so that the seat shall partake of the inclination of the back and foot rest rails, and said foot rest rails move on a changing centre."

117. For an *Improvement in the Mode of Supporting Table Leaves;* Henry A. Frost, Worcester, Massachusetts.

Claim.—"The application to table leaves of a self-acting swing brace or support, which shall operate by its own weight when the leaves are raised."

118. For an *Improvement in Cultivators;* Henry D. Ganse, Freehold, New Jersey.

Claim.—"1st, That shape of the upright parts or fenders, as described, in its application to the purposes described, by which the formost point of each fender is elevated to or above the surface of the ground, and the lower or cutting edge inclines backward from that point, so as to secure the result described. 2d, The combination of said fenders with the mould boards and wheels."

119. For an *Improvement in Screw Wrenches;* L. D. Gilman, Troy, New York.

Claim.—"The arrangement of the adjustable toothed plate with its springs, the toothed shank of the adjustable jaw, and the eccentric with its strap attached to the toothed plate."

120. For an *Improvement in Packing Journal Boxes;* Warner Groat, Troy, N. York.

Claim.—"The combination and arrangement of the packing ring and apparatus for tightening the same within the box, so that the packing in the inner end of the box can be tightened at the end, and the box be kept oil-tight without being pierced with holes."

121. For an *Improvement in Operating Valves in Direct Acting Steam Engines;* W. H. Guild and Wm. F. Garrison, Brooklyn, New York.

Claim.—"Giving to the valve the whole or part of the movement necessary to effect the change in the direction of the engine piston, by means of the steam acting upon a piston which is arranged and applied to work perpendicularly to the valve within a cylinder attached to a cap fitted to the back of the valve, and is supported against the pressure of the steam by a rocker, or its equivalent, by which it is caused to operate."

122. For an *Improvement in Looms;* David S. Harris, Coventry, Rhode Island.

Claim.—"The connexion of the shuttle guard in any way with the belt shipper, that when the loom is in gear the guard may stand over the shuttle race in such a way as to prevent the shuttle flying out of the loom, but when the loom is out of gear, the guard may be raised out of the way of the attendant to enable threads to be picked out or drawn through the reed, or such other manipulations to be performed as may be necessary."

123. For an *Improvement in Fire Proof Safes;* Richard G. Holmes and William H. Butler, City of New York.

Claim.—"Combining with the alum filling an alkali, in such proportions as that the alum, in becoming heated or melted, has a part of its acid neutralized by the action of the alkali, when the said filling is interspersed with and supported or restrained from settling down by cells of porous material, or frame work of porous substance."

124. For an *Improvement in Illuminating Vault Covers;* T. Hyatt, City of N. York.

Claim.—"The method of securing glass in the apertures of metal plates, or other surfaces, by surrounding the glass with a hoop or belt of lead, gutta percha, or other equivalent yielding substance, and forcing the glass so surrounded into the aperture or recess."

125. For an *Improvement in Looms;* Wm. S. Irish, Middlebury, Ohio.

"My improvement consists mainly in its simplicity, dispensing with the use of treadles, cording, strapping, &c., the facility and ease of changing from one species of fabric to another, cheapness of construction, durability, ease of putting up and keeping in order, and requires less power to operate."

Claim.—"The method of raising the harness by the immediate application of the cams to the shoes or projections of the harness."

126. For an *Improved Grate Bar;* J. S. Kirk and W. H. Elliot, Plattsburgh, N. Y.

Claim.—"The employment of a suspension rod for the support of the grate bar, or its equivalent. Also, the constructing of the wearing and supporting parts separately, so that said wearing parts may readily be removed and replaced."

127. For a *Tool for Boring Hubs to receive Boxes;* U. Kimble, Penfield, New York.

Claim.—"The oval-shaped box, with the nut with spurs on the underside resting on the oval-shaped box, in combination with the shaft, the knife, and the gauge."

128. For a *Method of Chalking Lines;* S. B. Knight, North Providence, R. Island.

Claim.—"The method of chalking a line by drawing it through the cylinder, or other vessel containing the fine chalk, and also through the rubber of leather, or other compressible substance, and this I claim, when used for chalk or other coloring material."

129. For a *Shingle Machine;* Chas. Leavitt, Quincy, Illinois.

Claim.—"1st, The elastic table, capable of being elevated and depressed by the means described, or their equivalents, in combination with the froe or splitting knife. 2d, The elastic shingle holder. 3d, The jointing knives, pivoted to the plane stocks, in combination with the bar, for the purpose of jointing the edges of the shingle with a drawing cut."

130. For a *Self-Adjusting or Anchoring Pump;* Thomas Ling, Shelby, Ohio.

Claim.—"1st, Connecting the piston or stationary part to a weight or anchor, by a flexible joint, or its equivalent, so as to allow the anchor to adapt itself to the bottom of the well without cramping the other parts. 2d, Connecting the anchor to the cylinder or moving parts, by means of the projections and slotted arms, or their equivalents, so as to draw the anchor from the well by means of the pipe and cylinder, or moving parts. 3d, The devices, or their equivalents, for guiding and steadying the upper end of the pipe, and discharging the water downwards into a box, having an opening in the side in which the pipe traverses, closed below the pipe by the plate, or its equivalent."

131. For an *Improvement in Charcoal Furnaces;* John McNeill, City of New York.

Claim.—"Supporting the retort tubes by a hollow or tubular beam or beams, with open ends, applied so that one end of each is in communication with the cold atmospheric air outside the furnace, and the other with the chimney or escape flue, whereby a current of cold air is caused to be induced through the beam by the draft of the chimney or flue, for the purpose of keeping it comparatively cool, preventing it burning, and rendering it a firm and durable support to the retort tubes. Also, constructing the furnace with one or more arched walls extending across it, to support the joints in the beams, when the said beams are made in two or more lengths, and also to support the side walls and roof."

132. For an *Improvement in Seed Planters;* Hiram Moore, Climax, Michigan.

Claim.—"Grooved seed distributing wheels, provided at the bottom of the grooves with partitions extending about one-third of their depth, in combination with the dash board."

133. For an *Improved Bill Holder;* Geo. W. Palmer, Boston, Massachusetts.

Claim.—"An oblong box of suitable size, for holding bills or papers, having upon one of its sides a hinged movable arm and attached spring, by which the papers are held in place."

134. For an *Improvement in Coffins;* David Sholl, Cincinnati, Ohio.

Claim.—"The production of a coffin, composed of terra cotta or pottery ware."

135. For a *Current Wheel;* Wm. S. Smith, Cedar Rapids, Iowa.

Claim.—"The construction of current wheels, with heads or hubs movable on the shaft."

136. For an *Improvement in the Manufacture of Boots and Shoes;* Henry G. Tyer and John Helm, New Brunswick, New Jersey.

Claim.—"The uniting of the outer sole and upper, manufactured wholly or in part of vulcanized india rubber, with the insole of boots and shoes, by means of cement, the cement passing through perforations made for the purpose in the upper."

137. For an *Improvement in Seed Planters;* Myron Ward, Owego, New York.

Claim.—"The adjustable slotted share, for the purpose of removing obstructions, and at the same time allowing the fine earth to pass through the slats, which share is made adjustable by means of a thumb screw and plate in rear. Also, the short compressing blocks on the periphery of the wheel, which compressers crowd the earth laterally over the seed, and at the same time indicate the place of the hill, and by which means the grain can be planted in check rows."

138. For an *Improvement in Cultivators;* R. P. Vanhorn, Jackson Town, Ohio.

Claim.—"The peculiar elongated rhombus-shaped wrought iron frame, and arrangement of teeth, the front angle bearing a light steel cutter tooth, and the rear angle a large shovel tooth."

139. For an *Improvement in Pulling Cotton Seeds;* Joseph Walker, Dover, England; patented in England, July 20, 1850.

Claim.—"Supporting and adjusting the concave bed by means of grooves cut within, or other equivalent devices, affixed to the side frame in such manner that the said concave shall be eccentric to the axis of the hulling cylinder."

140. For an *Improvement in Cultivators;* Wm. P. Zane, Woolwich, New Jersey.

Claim.—"The vine hooks, arranged in such a manner in relation to the cultivating teeth, that the said hooks will remove the vines out of the way of the said cultivating teeth, and allow them to operate upon the soil without injury to the vines."

141. For an *Improvement in Processes for Making Kerosene;* Abraham Gesner, Williamsburgh, New York, Assignor to the "Asphalte Mining and Kerosene Gas Co.," City of New York.

Claim.—"The process for extracting the liquid hydro-carbon, which I have denominated 'Kerosene,' from asphaltum, bitumen, asphaltic and bituminous rocks and shales, petroleum, and maltha, by subjecting any of these substances to dry distillation, rectifying the distillate, by treating it with acid and freshly calcined lime, and then submitting it to re-distillation."

142. For an *Improvement in the Manufacture of Zinc White;* Smith Gardner, City of New York, Assignor (through others) to Edward Kellogg, Brooklyn, New York.

Claim.—"The combination of the fire chamber, the vaporizing chamber or oven, and the oxydizing chamber."

ADDITIONAL IMPROVEMENT.

1. For an *Improved Lubricator;* Robert M. Wade, Wadesville, Va.: original patent dated June 6th, 1854; additional improvement dated March 27th, 1855.

Claim.—"1st, The division of the plug into the longitudinal chambers, and the relative positions of the feed and discharge openings in said chambers, so that while one chamber is discharging, a simultaneous feed will take place in the other. 2d, Disclaiming the tubes as mere vent passages, I claim their insertion relative to the feed openings of cup and plug, whereby they perform the double function of vent and steam passages; the feed openings of the plug passing under the tubes and discharging the steam contained in the plug, clear of the oil in the cup, before communicating with the feed channel of the cup."

Re-Issues for March, 1855.

1. For an *Improvement in Grain and Grass Harvesters;* John H. Manny, Rockford, Illinois; original patent dated October 17th, 1854; ante-dated June 15th, 1854; re-issue dated March 6th, 1855.

Claim.—"Making the outside or dividing finger hollow, so that while it affords sufficient room for the play of the end of the sickle, the bearing of the latter therein will not be so long as to afford a lodgment of the grain, grass, &c., in sufficient quantity to clog it."

2. For an *Improvement in Grain and Grass Harvesters;* John H. Manny, Rockford, Illinois; original patent dated October 17th, 1854; ante-dated June 15th, 1854; re-issue dated March 6th, 1855.

Claim.—"The combination of the reel for gathering the grain to the cutting apparatus, and depositing it on the platform, with the stand or position for the forker arranged and located to enable the forker to fork the grain from the platform, and deliver and lay it on the ground at the rear of the machine."

3. For an *Improvement in Grain and Grass Harvesters;* John H. Manny, Rockford, Illinois; original patent dated October 17th, 1854; ante-dated June 15th, 1854; re-issue dated March 6th, 1855.

Claim.—"The combination of the fence to compress the grain against, at the outer end of the machine, and guide it while sliding off the platform, and the position stand or seat for the forker at the inner end of the platform with the platform."

4. For a *Design for Metallic Coffins;* Martin H. Crane, Assignor to Crane, Breed & Co., Cincinnati, Ohio; dated Jan. 23, 1855; re-issue dated March 13, 1855.

Claim.—"The ornamental polygonal design for a metallic burial case or coffin."

5. For an *Improvement in Machinery for Separating Flour from Bran;* Issachar Frost, and Jas. Monroe, Albion, Michigan; original patent dated February 27th, 1849; re-issue dated March 13, 1855.

Claim.—"1st, The platform, (always at right angles with the sides of the bolt when not made conical,) or close horizontal bottom, when used in connexion with upright stationary or revolving bolt for flouring purposes. 2d, The opening for the admission of a counter current of air through the bottom and into the bolt, and the opening and bran spout, in combination with the platform. 3d, The upright stationary bolt, or bolt and scourer combined, with its closed-up top, except for air and material, or in combination with claims first, second, and fourth, or either of them, or their equivalents, to produce like results in the flouring process. 4th, The use of the revolving, distributing, scouring, nd blowing cylinder of beaters and fans, by which the material is distributed, scoured, and the flour blown through the meshes of the bolting cloth."

Designs for March, 1855.

1. For *Table Forks;* J. W. Gardner, Shelburne Falls, Mass.; dated March 20, 1855.

Claim.—"The peculiar configuration of the parts."

2. For *Cooking Stoves;* Jacob Beeseley and Edward J. Delany, Philadelphia, Penna.; dated March 20, 1855.

Claim.—"The design for Fanny Forrester Stoves."

APRIL 3.

1. For an *Improvement in Factitious Oils;* Henry W. Adams, City of New York.

Claim.—"The use of crude turpentine in a mixture made with it and the fixed oils."

2. For an *Improvement in Presses;* James P. Arnold, Louisville Kentucky.

Claim.—"Operating the shipper that moves the belt along the cones, by the descent of the platen whilst pressing, so that the power shall be increased with the resistance, until the material is pressed, and then allowing the shipper to run back at an increased velocity when the bale is ready to be removed."

3. For an *Improvement in the Manufacture of White Lead by Precipitation;* Richard Baker, Newark, New Jersey.

Claim.—"An improvement in the combination of apparatus, so arranged as to produce carbonate of lead by precipitation, more expeditiously and economically than by any other arrangement heretofore used for the same purpose. Connecting with an air pump a series of vertical distribution pipes, consisting of a great many in number, descending vertically from the main horizontal pipe, and passing down through the head of the precipitating vessel into the solution of sub-acetate of lead, one pipe at least through each square foot of surface of the top of the precipitating vessel, thereby traversing the solution with a great number of small jets or blasts of carbonic acid gas, causing a very rapid decomposition of the solution; as the vertical pipes cannot choke up with the ponderous precipitate, a constant blast from each pipe is thereby insured."

4. For a *Method of Lubricating Pistons of Air Pumps;* Abel Barker, Honesdale, Pa.

Claim.—"The transference of the lubricating oil from the bottom of the engine cylinder to the upper side of the piston thereof, for the purpose of insuring the proper lubrication of said piston."

5. For an *Improvement in Seed Planters;* Chester B. Borden, Benjamin S. Borden, and Aaron R. McLean, West Dresden, New York.

Claim.—"Attaching to the handle of an ordinary hoe, a chamber or box which contains the corn or seed to be planted, said chamber or box being provided with a slide, D, having a slot or recess in its lower end, which slot or recess may be increased or diminished in size by adjusting the small slide, E. The slide, D, being arranged so as to be operated by the fingers of the operator, and the spiral spring, for the purpose of depositing the seed or corn in the holes or furrows in the earth made by the hoe."

6. For *Improvements in Condensers for Steam Engines;* Louis Bollman, City of N. Y.

Claim.—"1st, The method of controlling the injection of cold water into the condenser by connecting the injection cock or valve with a piston, or its equivalent, which is exposed on one side to the presence of the atmosphere, and on the other to the pressure within the condenser, and is acted upon by variations in the pressure in the condenser so as to increase or diminish the injection as the said pressure diminishes or increases, and to stop the injection when the desired vacuum is obtained. 2d, The employment, for the purpose of heating a sufficient quantity of water to supply the boiler to a higher temperature than the water delivered by the air pump, of an additional injection pipe to inject the said quantity of water at the commencement of eduction into the eduction pipe or passage, the cylinder, or any convenient place near the entrance to the condenser, combined with a receiver, which is arranged and furnished with any suitable means of opening it at the commencement of eduction and injection to receive the said water, and of shutting it off from the condenser before the temperature of the latter is too much reduced."

7. For an *Improvement in Ships' Riding Bitts;* Thos. Brown, London, England.

Claim.—"The tubular metallic riding bitts, when entirely secured to a single deck of a vessel."

8. For *Adjustable Paddle Wheels;* Levi M. Dehart, Reading, Pennsylvania.

Claim.—"In combination with the hollow arms permanently fixed to the hub, the arms carrying the sections of the buckets, when said arms are so arranged as to be slid within the hollow arms by a rack and pinion, or its equivalent."

9. For an *Improvement in Anchors;* Richard V. Guinow, Brooklyn, New York.

Claim.—"The method of fitting a pair of movable flukes to a suitable anchor, so as to fit it to hold in soft or sandy soil, by means of the tie-rods, thimble, and collar."

10. For an *Improved Safety Port for Coal Holes;* Samuel W. Frost, Boston, Mass.

Claim.—"Combining with the door and the frame, or the vault opening, a safety guard applied thereto."

11. For *Improvements in Valves for Steam Engines;* Thomas Goodrum, Providence, Rhode Island.

Claim.—"1st, The rotary tubular valve, having openings and cavities, arranged to communicate with the induction, and with one, two, or more openings or ports leading

to one end, and a corresponding number of ports leading to the opposite end of one, two, or more cylinders, whereby the same valve is enabled to control the induction and eduction of steam to both ends of one, two, or more cylinders. 2d, The variable cut-off, consisting of two segments of cylinders, and plates applied within the tubular valve. 3d, Arranging the valve casing and the tubular valve with the axis of the valve, in line with the cylinder or cylinders, so as to bring the valve into an equally convenient position, relatively to two or more cylinders, and enable the length of the passages from it to the cylinders to be reduced to the greatest possible degree."

12. For *Direct Acting Hydraulic Steam Pumps;* Robert B. Gorsuch, City of N. York.

Claim.—"Effecting a water pressure upon the suction end of the pump plunger, in direct acting steam pumps, at or near the completion of the stroke, without diminishing the resistance against the forcing end of the plunger, for the purpose of closing the suction valves, filling the vacuous space in the pump chamber, preparing the force valves for opening and acting conjointly with the steam pressure upon the piston, whereby the steam valve is operated with precision, whatever may be its velocity."

13. For an *Improved Hose Coupling;* Smith Groom, Troy, New York.

Claim.—"A hose coupling composed of two parts, on one of which are spring clamps or jaws controlled by a friction ring, and on the other a groove into which said jaws or clamps take, the whole being so arranged when united as to make a tight joint, and yet allow one half of the coupling to turn on the other half without uncoupling it."

14. For an *Improvement in Ploughs;* Thos. J. Hall, Tawakana Hills, Texas.

Claim.—"The so hanging of the cutter to the beam as that it may swivel therein, in combination with the supports at the edge of the wheel."

15. For an *Improved Valve for Wind Musical Instruments;* G. Hammer, Cincinnati, O.

Claim.—"The combination of the bow, string, and the screw, for working themselves and preventing the string from slipping. Also, the privilege of applying the improved valve to all musical instruments to which such valves are commonly attached."

16. For an *Improved Mode of Loading Rifled Cannon;* L. Houghton, Philada., Pa.

Claim.—"For loading rifled or grooved cannon, the employment of a deep sabot at the base of the projectile, so as to be driven thereon, and into the grooves of the gun at the moment of discharge, for rendering said grooves effective in producing the rotation of the projectile."

17. For an *Improvement in Looms;* Barton H. Jenks, Bridesburgh, Pennsylvania; ante-dated January 8th, 1855.

Claim.—"The yielding rest or support for the picker, to break the sudden blow or concussion with which the shuttle impinges upon the picker, thereby preventing the filling of the cop from being jarred off and entangled, and relieving the picker from danger of being broken. Also, separating or freeing the picker from the end of the shuttle by the same movement which shifts the shuttle boxes, operating through a combination of levers, cams, and springs, or through levers, cams, or treadles, worked from any part of the loom."

18. For a *Double Acting Pump;* Benjamin F. Joslyn, Worcester, Massachusetts.

Claim.—"Forming a direct passage to admit fluids to one part of the cylinder, by means of a tube attached to and working with the piston, and passing through the other part and end, when applied to double acting pumps, or any other."

19. For an *Improvement in Rakes and Hay Elevators;* William J. Keeney and James R. Tarbox, Switzerland County, Indiana.

Claim.—"The combination of the apron, endless belt, and elastic clearers, either alone or in connexion with two driving wheels, clutches, and a rake, placed behind, for the purpose of raking and elevating hay."

20. For an *Improved Apparatus for Hoisting and Dumping Coal Cars;* Geo. Martz, Pottsville, Pennsylvania.

Claim.—"The combination of the coal car and its carriage with the hoisting carriage, in such a manner that whilst the hoisting carriage is guided vertically up the shaft by its ways, the carriage of the coal car is guided by the independent ways in such a man-

ner as to tilt the car when it obtains the proper elevation, and place it in such a position that its contents will be self-discharged into the shute."

21. For an *Apparatus for Feeding Paper to Hand Printing Presses;* Ebenezer Mathers and William D. Siegfried, Morgantown, Virginia.

Claim.—"The feeding hand presses, automatically, by means of the operation of the clamps, guide rods, cords, weights, pulleys, catches, and springs."

22. For an *Improvement in Cotton Gins;* James B. Mell, Riceborough, Georgia.

Claim.—"The combination of the beater, card cylinder, brushes, and plate."

23. For an *Improvement in Lancets;* Henry Mellish, Walpole, New Hampshire.

Claim.—"The construction of a lancet, in combination with a charger and piston inside its blade, for the purpose of depositing vaccine, or other matter, in a puncture made for that purpose, before the lancet is drawn."

24. For an *Improvement in Coal Hole Covers;* F. H. Moore, Boston, Massachusetts.

Claim.—"The method of securing the coal hole cover by means of the rods, or their equivalents, whereby the cover may be raised more or less, as required, for purposes of ventilation, or for the introduction of coal, and all dangers to passers by is avoided."

25. For an *Improvement in Breech Loading Fire Arms;* R. White, Hartford, Conn.

Claim.—"1st, The application of the sliding breech to operate in connexion with the trigger through a tumbler, in substantially the same manner as the hammer in ordinary fire arms, thereby making the breech serve not only its proper purpose of closing the rear of the chamber, but as the hammer for effecting the explosion of the charge. 2d, The spring plate, applied to serve as a guide to conduct the cartridge into the open chamber, and as a guard to prevent the cartridge falling out at the rear of the chamber, before the breech is liberated."

26. For an *Improved Stove Pipe Tube;* Thomas Moore, Fair Haven, Vermont.

Claim.—"The double and adjustable concentric tubes, or stove pipe thimbles."

27. For an *Improvement in Pulley Arrangements for Dumb Waiters;* Andrew Murtaugh, City of New York.

Claim.—"The manner of arranging and suspending the waiter and weight between the cords, arranged double over pulleys."

28. For an *Improvement in Seed Planters;* Ives W. McGaffey, Syracuse, New York.

Claim.—"The combination of the fertilizer tilt apron with the seed distributing roller."

29. For a *Fire Proof Floor and Ceiling;* F. A. Peterson, City of New York.

Claim.—"The method of making fire proof floors and ceilings, by means of metallic flanched beams, in combination with tile tubes interposed between and resting on the flanches of the beams, and filled in above."

30. For a *Fire Escape Ladder;* Stephen R. Roscoe, Carlisle, New York.

Claim.—"The combination and arrangement of the mortise, tenon, spring latch, hook, and the groove in which it traverses. In combination with the above described sectional ladder, I claim the traversing platform and traversing roller, so constructed and arranged as to allow the sections of the ladder to be operated for fire escapes and other purposes."

31. For an *Improvement in Railroad Car Seats;* Alpheus D. Smith, Meredith, N. Y.

Claim.—"The combination of the arms which project from the back of a car seat, with the movable bars, which are combined with the car seat, and its arms, or their equivalents, in such a manner that by the aid of the shoulders on the standards, the back of the seat may be supported in the proper position for day riding, or be elevated into the proper position for night riding, and supported in that position."

32. For *Chain Pumps;* Arcalous Wyckoff, Columbus, Ohio.

Claim.—"The application of an elastic or other suitable valve, to an endless chain pump cylinder, said valve being arranged so as to be capable of only opening upward."

33. For an *Improved Protector for Lamp Shades;* Chas. Wilhelm and Anna C. Wilhelm, Philadelphia, Pennsylvania.

Claim.—"The introduction of mica as a transparent non-conducting material between the shade and the frame, for the purpose of preventing the shade from taking fire, or being otherwise injured, whilst the light is as free to be reflected as though there was nothing interposed between them."

34. For an *Improvement in Bank Locks;* C. Gustav Mueller, Charleston, S. C.

Claim.—" 1st, A key provided with extension bits, the individual length of each of which can be altered at pleasure, and still be applicable to the lock. Also, the arrangement of the plates and slides for preventing any friction, and so as to prevent the possibility of feeling how the plates or slides are connected. Also, the bars, having saw toothed racks, as arranged with the sliding bars, and the projecting pins for operating them from the outside of the lock. Also, the arrangement of the horizontal changeable sliding pins which are moved by the bars, the rack toothed wheels or segments, and forked lever, which is moved by the projection on the circular plate. Also, as arranged, the bars and the stationary plate for holding the pins when they are withdrawn from said bars. Also, the arrangement of the knob, the collar with its bent arm, and the circular plate for turning and holding said plate. Also, as arranged, the rod of the inner knob, the lever 2, shaft, lever *a*, plate, and its spring for connecting said knob with the bars and operating them."

35. For an *Improvement in Repeating Fire Arms;* Rollin White, Hartford, Conn.

Claim.—" Extending the chambers of the rotating cylinder right through the rear of the said cylinder, for the purpose of enabling the said chambers to be charged at the rear, either by hand or by a self-acting charger. 2d, The application of a guard to cover the front of all the chambers of the cylinder, which are not in line with the barrel, or any number thereof which may have been loaded, combined with the provision of a proper space for the lateral escape of the exploded powder, whether the said space be between the cylinder and guard, or in rear of the cylinder, and whether the said guard be constructed with a recess to receive the balls, or be of such form as merely to stop the balls. 3d, Combining a charging piston with the hammer by means of gearing, or by the equivalent thereof, in such a manner that by raising the hammer to cock the lock, the piston is moved towards the chambered cylinder, to force a cartridge from the magazine into one of the chambers thereof, and by the falling of the hammer the piston is withdrawn to allow a new cartridge to be supplied, ready to be driven into the next chamber of the cylinder as the hammer is again raised to cock the piece. 4th, Furnishing the hammer with an attachment, by which, in the act of falling, it may close the mouth of the magazine before exploding the priming, and thus protect the charges within the magazine from ignition."

36. For an *Improved Repeating Fire Arm;* Rollin White, Hartford, Connecticut.

Claim.—" 1st, The method of combining and applying the magazine and charging tube, either for cartridges or priming, to wit: the charging tube being arranged in line with the chamber or one of the chambers, or the nipple or one of the nipples of the piece, and the magazine being arranged in such a manner relatively thereto, that the cartridges or caps lie side by side to be sideways, one by one as required, into the charging tube by gravitation, a spring, or other means, on the retraction of the said piston from opposite the magazine, and to be fed into the chamber or on to the nipple by the movement of the piston towards it. 2d, Combining the rotating chambered cylinder with the charging piston, or its equivalent, so that by the operation of retracting the charger after charging a chamber of the cylinder, the cylinder shall be rotated to the extent required to bring a new chamber in line with the barrel. 3d, Combining the hammer with the charging piston, so that the operation of moving the charging piston to drive a cartridge from the magazine into the chamber, the hammer shall be raised to cock the lock. 4th, The spring protecting plate, applied to fall into notches in the rear of the rotating cylinder, to protect the other charged chambers from the effects of lateral fire from the discharge of the chamber which is in line with the barrel."

37. For an *Improvement in Ploughs;* Noah Warlick, La Fayette, Alabama.

Claim.—" The whale lance-shaped point, having a notch in its upper side to receive the lower end of the coulter, in combination with said coulter and the Y-shaped adjustable double brace."

38. For an *Improved Excavating Machine;* C. Williams, Jackson, Tennessee.

Claim.—"Having the frame or shaft of the scoop or shovel formed of two bars, and having said bars working between friction rollers in guide plates at opposite sides of the pole."

39. For *Mechanism by which Approaching Vehicles Open and Close Gates;* Enos Woodruff, Elizabethtown, New Jersey.

Claim.—"1st, Applying weights, in manner specified, or any similar manner, to the operating the gate. 2d, The application to gates of mechanism for causing both latches to lift at the same time. 3d, The application of catches with one side higher than the other, to a rotating gate. 4th, The manner of preventing the tread of an animal from opening the gate, or any mode analogous thereto."

40. For an *Improvement in Cultivators;* Francis L. Smithson, Mecklenburgh Co., Va.

Claim.—"The combination of the harrow teeth and cylinder in tobacco cultivators."

41. For an *Improved Arrangement of Means for Freeing Steam Boilers from Sediment;* Hiram Strait, Covington, Kentucky.

Claim.—"The arrangement and combination of the valved partition, blow-off pipes, and cock or valves, so as to expel its sediment, mud, scales, impurities, or incrustations, at any time and in a few minutes, by the joint or separate force and pressure of its own steam and water, without exhausting either or suspending any of its ordinary duties or business, and thus render a steam boiler strictly and thoroughly self-cleaning."

42. For an *Improved Breech Loading Fire Arm;* G. H. Soule, Jersey City, N. J.

Claim.—"The use of the double acting cam, in combination with the charging chamber and breech piece, having an opening in it for cutting off the end of the cartridge, and discharging the fragments thereof from the charging chamber, the said parts made and operating in combination with the barrel and magazine of a gun."

43. For an *Improvement in Folding Bedsteads;* Wm. Stoddard, Hingham, Mass.

Claim.—"Making the side rails of bedsteads in sections, hinged together, and also to the head and foot posts, so that they will fold together, in combination with the slats which support the bedding, which slats are so constructed and provided with pins or projections near the ends of them as to brace or hold the folding rails firm when the bedstead is extended."

44. For an *Improved Grain Cleaner;* Benj. T. Trimmer, Parma, New York.

Claim.—"The construction and arrangement of the india rubber scroll and spring teeth, regulated by the bridge-tree."

45. For an *Improvement in Washing Machines;* G. W. Edgcomb, Lima, Indiana.

Claim.—"The alternating radial arrangement of the tapering rubbers upon the under side of the actuating disk, and upon the bottom of the tub."

46. For an *Improvement in Harrows;* Charles Clareni, Assignor to self and George P. Field, City of New York.

Claim.—"Making the rotating harrow in flexible segments."

47. For an *Improvement in Scrapers for Removing Dirt from Boots and Shoes;* Ozro A. Crane and Henry J. Lewis, Assignors to Ozro A. Crane, Green Point, N. Y.

Claim.—"The method of causing the brushes to accommodate themselves to any size or shape of boot or shoe, and brush off both sides at once, by so attaching said brushes that they shall be forced together by springs."

48. For an *Improvement in Fixtures for Curtain Rollers;* J. Hartshorne and Dexter H. Chamberlain, Assignors to John Hartshorne, Boston, Massachusetts.

Claim.—"The bent socket pivoting upon the window jamb, and secured thereto by means of screws, whereby sufficient friction may be placed upon the rod to balance a curtain of any size or weight, without the use of springs or other contrivances for the purpose."

MECHANICS, PHYSICS, AND CHEMISTRY.

On the Manufacture and Application of various Products obtained from Coal (Coal-gas excepted.) By Prof. F. Crace Calvert, F. C. S., &c.*

(Continued from page 285.)

Discussion.—The Chairman said it now became his duty to invite discussion on the very interesting paper just read, and he was sure all must be pleased with the animation and vigor with which the subject had been brought before them. Mr. Crace Calvert was a bright example of the importance of that happy alliance between England and France which they were all anxious to encourage. Mr. Calvert studied chemistry under the first French chemists, Chevreul and Dumas, and so long did he remain abroad, and so assiduously did he devote himself to his studies, that when he returned to England he had lost his native tongue. He was glad however now to find that he had regained the proper use of his own language, and that he still retained all the animation of our neighbors. The subject which Mr. Crace Calvert had brought before them was not only of great practical importance, but of great philosophical interest. When lecturing in this room on the Results of the Exhibition of 1851, he (Dr. Playfair) declared that the great end in modern civilization was to effect an economy of time, or to make the most refuse products conducive to the advantage of manufactures and arts. When coal gas was first introduced into use, it was contended that there was an intolerable quantity of refuse for which no use could be found, but now there was not one particle of that refuse, with the exception of the naphthaline, which was not already of great commercial importance. So important indeed had the waste products become, that many of their manufactures could not get on without the oils and dyes produced from them. Mr. Crace Calvert in alluding to the various products from coal, with the exception of the gases, had divided them into aqueous and tarry, and if he (Dr. Playfair) alluded to them, it was only to call their attention to some points which Mr. Crace Calvert had not noticed. That gentleman had shown them how alum was obtained, and had spoken of it with a fondness as though it were a child of his own, and he had pointed out its importance in dyeing; but whilst dilating on the importance of ammonia in its general applications, he did not tell them that it was from that fetid mass that ladies' smelling bottles were filled, and that they derived sal volatile. Then, again, benzine had a most extraordinary effect in cleaning white kid gloves, as he could testify, and that, too, without leaving that roughness which generally attended the operation. Then with regard to carbolic acid, it was expected to prove a most valuable antiseptic, though it had hitherto not been much employed, excepting in the preservation of wood. Mr. Crace Calvert, in speaking of several of these discoveries, had referred to a certain gentleman in Manchester, but he had too much modesty to tell them that that gentleman was Mr. Crace Calvert himself; and with reference to carboazotic

*From the Journal of the Society of Arts, November, 1854.

acid, should it prove as valuable a febrifuge as he anticipated, it would stamp Mr. Crace Calvert as one of the greatest benefactors of mankind. He had next referred to naphthaline, the odor of which chemists had not yet been able to get rid of—though it would yet be got rid of, and the substance rendered useful in dyeing. He had also shown them how the refuse of coal might be made useful in the manufacture of solid paraffine and paraffine oil. Paraffine obtained from other sources had been long known as a most useful lubricator, and was originally proposed for the works of chronometers. Paraffine had this advantage—it would not combine with the oxygen of the air, and thus become rancid. Paraffine oil from coal possessed all the advantages of solid paraffine, and was now used almost all over the country for lubricating machinery. The reason why the beautiful paraffine candles they had been shown that evening were not brought extensively into use, was, that the manufacturers of the article had a demand for it in its liquid state beyond what they could meet, and therefore it was not to their advantage to manufacture it into candles. He had only thus run through the principal heads in order to point out the subjects for discussion, and should now be happy to hear any gentleman upon it.

Mr. Winsor trusted that he might be allowed to express the deep debt of gratitude which they must all owe to Mr. Crace Calvert for the pleasure, entertainment, and information they had derived from his paper that evening. He had had the honor of being a member of the Society of Arts for upwards of thirty years, and being the son of the introducer of gas lamps into England, if not throughout the whole world, he trusted he might be excused for presuming to address them. He certainly had felt somewhat astonished at what he had heard that night. He recollected when Dr. Playfair was lecturing on the Great Exhibition, in alluding to his father, he spoke of the indomitable perseverance of Mr. Winsor, and he now begged to thank him for that testimony to his father's memory. He now wished to call their attention to the evidence given before Parliament in 1809, when the Chartered Gas Company was applying for its Act of Incorporation. In the preamble of their bill it was set forth that the products of coal were gas, pitch, tar, essential oils, and ammoniacal liquor, and they then produced in the House of Commons specimens of those products of which since so much had been made. He now had great pleasure in moving a vote of thanks to Mr. Calvert for the mass of information which he had laid before them, and for having shown them how the various products of coal would benefit the whole country, —as gas had for several years. He should be happy at any time to render any information to the Society on the gradual progress of gas manufacture, and he hoped ere long to embody in a work which he would lay before the public, the history of gas-lighting for half a century, leaving it to the scientific world to determine upon its value.

Mr. Varley seconded the motion, and expressed the great satisfaction with which he had heard the observations relative to extending a knowledge of science amongst the people.

The Chairman said, that before putting the question, he would ask if any gentleman wished to make any observation, and he particularly alluded to Mr. Bethell as having had his invention noticed.

Mr. Bethell said, that it was most difficult to touch the various questions brought before them that evening without occupying several hours of their time. Mr. Crace Calvert had brought the subject before them in a very lucid and talented manner, though he had been obliged to notice very cursorily many points for want of time. The possibility of the preservation of wood by tar oil had struck him whilst seeking for some material to preserve wood for railway sleepers. The stone sleepers originally laid down were found to destroy the carriages very quickly—and it being desirable to use some softer material, wood naturally presented itself. How to preserve it then became a question, and it was proposed to use solutions of various chemical salts. It was considered that the decay of wood was principally caused by the albuminous nature of the sap, and that if some matter could be obtained to coagulate it, the decay would be stopped. Corrosive sublimate, and sulphate of copper, were therefore tried for this purpose. It was found, however, in practice, that this process was too expensive, and besides, although it prevented the putrefaction of the sap, it had no effect on the fibrous matter of the wood. He then determined to try the oil of tar, and he was induced to do so from finding that the agents used to preserve the Egyptian mummy were of an asphaltic nature—asphaltic oils being collected in great quantities on the Persian Sea, and in different parts of Egypt, where, in consequence of the heat, it exuded through sandy rocks, &c. Finding that this substance was used for making mummies, he considered that what would preserve animal flesh would preserve wood. He, therefore, determined upon using oil of tar, and then came to be considered the mechanical method of making the wood absorb it. He found that where wood had been used perfectly dry it stood uninjured, if protected from the weather, for ages, as was to be seen in the roof of Westminster Abbey; and he determined so to saturate the wood with oil of tar as to render it impervious to water. The result had far exceeded his expectations. A few days ago some sleepers were taken up between Manchester and Crewe, which had been laid down in 1838, in order that they might be replaced by some of a heavier description, when it was found that the old sleepers were perfectly sound, and they were about to be used on parts of the line where there was less traffic. The unprepared sleepers never lasted more than four or five years. A great many improvements in this country were stopped by the prejudice which people had against anything bearing the smell of gas. For instance, pitch and other products of tar were highly-important in ship-building, yet, so prejudiced were the English ship-wrights against coal-tar and pitch, that they would only use the tar and pitch from Archangel or Stockholm, though it cost ten times as much as the English. In the Mediterranean the native vessels which were not coppered suffered very severely from the worm, and the Maltese and Sicilians found that the Archangel and Stockholm pitch would not protect them, but with the coal pitch and tar no worm would touch the vessels, and there was, therefore, a great demand for the English pitch and tar in the Mediterranean, the boat-builders of which would readily give more for it than for the vegetable pitch or tar; but there was a prejudice against it in England because it was to be obtained cheaply at our very doors. In fact, all pitch and tar from the mineral kingdom was much

better and stronger than that from the vegetable, and much more of a preservative. By the injection of the carbolic acid from tar, mixed with a little olive oil, into the veins of the body, they might keep anatomical subjects fresh for many weeks, and it would have no effect upon the scalpel, which showed the great power and usefulness of the carbolic acid; and the only reason why it had not been extensively used for the preservation of meat was that the gaseous smell would be more or less retained.

In answer to a question from Mr. Winkworth, Mr. Crace Calvert stated that there could be no doubt that when they wished to disturb the streets, paved as Manchester was, for the gas or water pipes, that as the stones had to be raised by the pick-axe there was considerable labor required beyond that for removing the ordinary pavement. The reason why it was not more generally used he could only suppose was that each locality had its own peculiar manner of doing things; but any one who rode over the streets of Manchester could not fail noting how free they were from the jolting and reverberation felt in London and other cities.

The Chairman, in putting the motion, said he could not help remarking how deeply he sympathized with the remarks of Mr. Crace Calvert relative to the popularizing of science; and he might take that opportunity of informing them that so desirous were the Government to aid in that object that they had prevailed on Dr. Hofmann, one of the most eminent chemists of the day, to deliver a course of lectures on chemistry at the School of Mines, for the almost nominal charge of 5s. the course—instead of about £5—and sure he was that it was as little as it could be done for to remunerate the professor at all.

Mr. Crace Calvert returned thanks, and expressed the gratification he felt at what he had just heard from Dr. Playfair, trusting that the same advantages would shortly be extended to Manchester, Birmingham, and other places. Sure he was, if Dr. Playfair had but a few coadjutors as enthusiastic in extending a knowledge of science as himself, it would soon become as popularized as the most earnest lover of science could desire.

On the Flow of Water through Pipes and Orifices. B. Mr. J. Leslie, M. Inst. C. E.*

The author having been professionally called upon to report on a small scheme of water supply, in which it was proposed to lay down a pipe with an unusually small declivity, was induced to have a set of experiments made on the discharge of a new lead pipe of $2\frac{1}{2}$ inches diameter and 1086 feet in length, with heads varying from $\frac{3}{16}$ths of an inch to 10 feet. This pipe was laid in a coil of about 70 feet in diameter, and was afterwards successively shortened into lengths of 540 feet, 270 feet, 100 feet, 25 feet, and 10 feet. Other experiments were also made with pipes of $1\frac{1}{4}$ inch and $1\frac{3}{4}$ inch diameter.

As much care as possible was taken to insure the escape of air; but

* From the Lond. Artizan, March 1, 1855.

the results were in some cases so anomalous as to induce the belief that complete success had not, in this respect, been always obtained.

The pipes were also carefully joined and soldered, and it was believed that, with one trivial exception, no internal obstruction had existed.

The observations, which were exceedingly numerous, were stated to have been made with much care by Mr. John Lamond, an assistant of the author; and these had been tabulated at great length, and were annexed to the paper.

The object of the author having been to institute a comparison between the deductions of hydraulicians and the results of direct experiment, he had adopted, as a standard of comparison, a formula which he believed to be due to Du Buat, and from that had calculated "the ratio of actual discharge to Du Buat's formula."

The formula employed was thus expressed :—

$$v = \frac{3000\sqrt{d}}{\sqrt{\frac{l}{h}}}$$

in which v was the velocity per minute, l the length of the pipe, increased by 50 diameters, and d the diameter of the pipe, all in feet.

For the discharge (D,) in cubic feet per minute, this formula became

$$D = \frac{2356{\cdot}2\, d^{\frac{5}{2}}}{\sqrt{\frac{l}{h}}}.$$

Adopting this formula, the following were a few of the results obtained from the pipe $2\frac{1}{2}$ inches diameter :—

Pipe $2\frac{1}{2}$ inches diameter, 1086 long + 50 diameters = 1096 feet.

Head. Ft.	In.	Gradient.	Observed discharge, cubic feet per minute.	Ratio of actual discharge to Du Buat's formula.
0	0 3-16	1 in 70,256	·0444	·252
0	1	" 13,152	·2048	·503
0	$1\frac{3}{4}$	" 7,515	·241	·448
0	$2\frac{1}{2}$	" 5,260	·4412	·684
0	$5\frac{1}{2}$	" 2,391	·7407	·776
1	$5\frac{3}{8}$	" 757	1·4634	·863
2	$9\frac{3}{8}$	" 394	2·22	·945
4	$9\frac{1}{8}$	" 230	3·	·975
7	$0\frac{1}{8}$	" 156	3·53	·945
9	$11\frac{7}{8}$	" 109	4·286	·961

(It was shown in the discussion, which was only commenced, that the formula relied upon by the author was not that of Du Buat, which when applied gave results more closely approximating to those of the experiments than were obtained by the formula employed in the construction of this table.)

Numerous experiments were also made on simple orifices—on short tubes placed sometimes vertically, and sometimes horizontally—and on vertical pipes, from which coefficients of discharge, greatly at variance with accepted data, had been deduced; but it was afterwards discovered that the apparent anomaly disappeared if the active head were measured by the difference of level between the surface of the water in the cistern and the point of exit from the pipe, or the difference of level of the water in the upper and the lower cisterns.

Observations on a large scale were also made on the pipes of the Edinburgh Water Company. The "Crawley pipe" was 15 inches in diameter and 44,400 feet long, with a differential head of 226 feet. The actual discharge was 255 cubic feet per minute; whereas, by the formula, it ought to have been 294 cubic feet per minute. This pipe was, however, thirty years old, and was known to be considerably reduced in diameter by incrustation.

The "Colinton pipe" was 16 inches diameter, 29,580 feet long, with a differential head of 420 feet. The mean of fifteen observations gave an actual discharge of 571 cubic feet per minute; whereas the formula required that the discharge should have been 575 cubic feet per minute. This pipe was only eight or nine years old.

A section of the same pipe, of 25,765 feet in length, with a differential head of 230 feet, yielded, on a mean of twenty-six observations, 440 cubic feet per minute; whereas the discharge by the formula should have been 457 cubic feet per minute.

Another section of the same pipe, 3815 feet in length, with a differential head of 184 feet, yielded 1215 feet per minute, instead of 1063 expected from the formula; but a new iron pipe of $2\frac{1}{2}$ inches diameter and 1150 feet long, with about 11 feet of fall, yielded about what was due by formula to a pipe of $2\frac{1}{4}$ inches diameter.

Observations were also made on the Dundee conduit, which was 2 feet broad, with rectangular sides and a bottom of smooth stone slabs, with the following results:

Fall 1 in 1000.

Depth.	Calculated discharge.	Actual discharge.	Actual average ascertained velocity.	Velocity by floats at surface.
Inches.	Cubic feet.	Cubic feet.	Cubic feet.	Cubic feet.
6	109·	110·09	110·09	128·5
7	134·	134·83	116·	129·7
8	160·	162·16	121·6	133·1
9	186·	184·61	123·	136·7
10	213·	214·28	128·6	138·1
11	240·3	240·	131·	140·
12	268·	266·6	133·3	146·7

The formula used in this instance might be thus expressed:—

$\frac{15}{16}\sqrt{\text{hyd. mean depth}+\text{fall in feet per mile}} = \text{velocity in miles per hour.}$

The discharges by the sluices of the dock-gates of Dundee and the lock-gates of the Monkland Canal were also ascertained and tabulated. (The mean of the first seven observations gave a coefficient for feet of 5·3, and of the next four observations, omitting one imperfect observation, of 5·25, which were consistent with the received formula.)

A few experiments were also undertaken with respect to the flow of water over notch-boards; and some investigations were made for the purpose of determining whether the theoretical addition of 50 diameters to the length of the pipe was practically correct.

The author's conclusions were, that while "Du Buat's" formula gave very accurate results at moderate rates of inclination, it gave a great deal more than the actual discharge with very low gradients, and very considerably less with steep gradients.

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*On Steam Boiler Explosions and the Explosive Force of Highly Heated Water.** By JOHN SEWEL, Assoc. Inst. C. E., Great Western Railway, London.†

The frequent occurrence of disastrous boiler explosions has largely attracted scientific, practical, and popular attention, and to endeavor to guide this attention to some practical benefit is the object of this paper. The investigations which take place after explosions, chiefly turn on the magnitude of the force which produced the visible destruction. That destruction it is conceived may be readily traced to the elastic force of the body of water and steam when suddenly expanding, without ascribing it to greatly increased pressure per square inch before explosion takes place. If this can be shown satisfactorily, it will lead to more attention to evidence often discredited, because it appears at variance with the effect of the explosion, and the assumed strength of the boiler. In each instance of explosion there are two opposing forces to be estimated—first, the strength of the boiler; and second, the strength of the steam. The first possesses a nearly non-elastic power of passive resistance, but the second an expansive power of vast extent, which concentrates its entire force with terrible effect on the smallest yielding of its passive opponent. Such are the antagonistic forces, and such is the difference in their relative powers; but a few remarks on each of them will render these differences more appreciable.

First, then, is the question of the real strength of the boiler. Mechanically, this depends upon the design, the materials, and the workmanship: when all three are good, a maximum strength is attained, but when any one part of them is defective, that defect rules the strength of the boiler, as bad gradients rule the tractive power of locomotives. A serious evil attends these local defects, from their becoming more acted on by the expansive and contractive motion of the boiler than the other parts. Thus slowly the cohesion of the iron is injured at these points, until some day it fails to resist a pressure it had again and again, it may be years, resisted with safety. The materials used in constructing boil-

* From the London Mining Journal, November, 1854.

† Read at the British Association Meeting, Liverpool, September, 1854.

ers are chiefly iron and copper, and various experimenters have given reliable data of their cohesive power—of the rapid loss of strength in copper by increase of temperature, of injury to the best iron by long-sustained vibrations, and the serious loss of strength by the ordinary single riveted joints. These researches serve as guides to the designer and constructor of boilers, that the passive resistance at all points may far exceed the elastic power of the steam. The forms of boilers are so often modified by circumstances and by new plans, that no time will be occupied in discussing this part, but it is evident that, whatever the form, the material should be of the very best quality, since the cost of labor may be the same for both good and bad materials, and the difference resolves itself into a few shillings per ton of the materials required. The best materials and the best designs are, however, liable to injury by defective construction, for the mere economy of a little skilled labor.

Some of the chief defects in construction arise from shearing the edges of the plates, punching out the rivet holes, and drifting ill-matched rivet holes in a line by steel wedges, or "drifts," as they are technically called. These sources of injury can all be avoided by planing the edge of the plates, and boring the rivet holes when the plates are in their final position to each other. Shearing injures the fibre of the iron, and shorn strips exhibit a loss of 8 to 10 per cent. as compared with planed strips of the same iron of equal section. Punching out the rivet holes is another source of disturbance to the fibre of the iron, besides the actual loss of metal cut out, which is only made up about 3 or 4 per cent. in the fastening of the rivet head, and when rivets are over hammered, not made up at all, but, on the contrary, cause leakage. To such an extent is the aggregate of this loss, that a single riveted joint is from 40 to 44 per cent. weaker than the plate clear of the rivets. Thus, the boiler is only about half its nominal strength, even when no injury is done to the plates by drifting the rivet holes together. It is difficult to estimate the injury done by drifting, more especially with inferior iron, since it may be carried to that extent as to cause incipient fracture between the rivet holes, and remain unseen after the rivets are fixed. In all such cases the real strength of the boiler is only a fraction of its nominal strength. The weakening effect of the rivet holes might be remedied with a thickened margin all round, so that the part left would equal the plate in strength.

Some years since the writer called the attention of a leading manufacturer of boiler plates to this description of plates, but some objections were urged as to the difficulty of rolling thick edged plates, but it cannot be an insuperable one in these days of progress. Another source of injury to boilers, and one that is seldom noticed, is the liability of the plates being subjected to chisel cuts, and the joints to caulking tool nicks. Experiments on the strength of iron have, in many instances, accidentally shown the decided loss of strength by abrasions of the surface so slight that they were not detected until the early fracture of the iron showed their injurious effect, and ordinarily little care is taken to avoid such abrasions of the surface in making boilers. With such cuts or nicks at any part of a boiler, where the vibrations of contraction and expansion are arrested by any sudden change in the thickness or level of the surface, the fibrous structure of the iron is liable to slow but certain

injury. Analogous to this source of fracture are the numerous well-known instances of railway axles breaking with more or less depth of a crystalline appearance from the surface, but with the central portion fibrous. Much discussion has taken place on this apparent conversion of iron, originally fibrous, into crystalline state, but it appears to the writer that this conversion is strictly local, and confined to a sectional line, where some change of the diameter of the axle-journal arrests the surface wave of vibration produced by the oscillation of the vehicle, so that a broken axle may exhibit a crystalline appearance at the fracture and be quite fibrous on each side of that fracture. Generally the fracture presents a worn appearance more or less deep, next a crystalline aspect, whilst the centre shows the original fibrous structure of the axle. Incipient fracture had commenced at the surface, and attrition afterwards worn it there, whilst the steadily deteriorating vibratory concussions were destroying the fibrous iron in the line of these concussions, until fracture took place under an ordinary load, which had been safely carried many hundreds of times. It is well known to practical men that fractures chiefly occur at the angle of the journal next the wheel, and appear to be due to the waves of vibration being arrested by these angular changes of the surface. The cohesion is ultimately injured there, beginning at the surface, and gradually deepening; therefore the time of fracture will be more or less prolonged, according to the peculiar circumstance of each case. The crystallization is thus believed to be confined to the line of fracture, where contrary currents meet, or are arrested by irregularity of surface; and if this is a correct view of the cause of these axle fractures, it shows that whenever iron has to sustain numerous constant vibrations, whether produced by motion as in railway axles, or by heat and pressure as in boilers, abrupt angles or shoulders should be avoided, so far as it is practicable to do so. If, then, the vibrations to which railway axles are subjected cause their fracture in a few years under the most ordinary circumstances, it may be fairly inferred that boiler plates are as liable to injury, by the vibrations of heat and pressure, as railway axles are to those of motion, and that a boiler plate may equally fracture under ordinary circumstances, often previously withstood. It is of obvious importance that all boilers should be carefully made and tested, and that the consequence of any defect of workmanship may be clearly understood and early discovered. Important as is a good boiler, yet with few exceptions its manufacture is in a very rude state. The engine is carefully fitted up, and where bolt holes are required additional material is given, whilst these holes are carefully drilled, but the reverse of all this takes place with boilers as commonly made. Shearing, punching, drifting, and caulking, show a very primitive mode of making boilers, and the continued use of plain boiler plates, indicates how little has been done to compensate the serious loss of 40 per cent. of the strength by the rivet holes. It is only a question of first cost, for there exists no practical difficulty in constructing a boiler as well proportioned, and as carefully put together, as the engine. And what is this cost compared to the loss caused by explosions? From what has been stated, it is evident that, as ordinarily made, the real strength of a boiler is very much less than its nominal strength, but that by an improved form of plates,

and superior workmanship, the boiler might become a fitting partner to the engine in proportions, in workmanship, and in real strength. Having shown the ordinary sources of inherent weakness in boilers, and that they could be greatly improved; the antagonistic force of steam which they have to confine, comes to be considered under the second division of this subject—or the real strength of steam and water in explosions. It is usual to estimate the force of steam by its distributed pressure in the boiler, and under ordinary conditions this is correct; but an explosion introduces extraordinary conditions, by concentrating on one point the whole of the acting and expansive forces in the boiler. The steam and boiling water, in a boiler working regularly, may be compared to the gentle undulations of the tidal wave on a fine day. Each has its own atmosphere, and each its own body of water in motion. Steam is the boiler atmosphere, amongst which the water rises and falls, by disturbing causes, with equal facility as the tidal wave varies by atmospheric currents or other causes. In locomotive boilers the gauge glass gives the means to observe the full influence of gravity in an atmosphere of steam as high as of 135 lbs. per square inch, or that of nine atmospheres altogether. When this steam is suddenly cut off from the cylinder, and the velocity of the boiler is checked, the water obeys the laws of gravity and motion, by rushing forward to the front end of the boiler, with a corresponding fall at the fire-box or back end, just as a rider at full gallop is thrown forward when his horse is suddenly stopped. In a calm day the stately trees seem to defy any possible atmospheric force, yet even in our own island, the storm frequently prostrates these giants of the forest, and injures the structures of art. Neither is the strength of ships, nor the skill of the mariner, tried on a calm day, but the agitated ocean, too frequently bears witness to the force evoked by atmospheric influence, when directed towards some common centre of disturbed equilibrium. In like manner the boiler appears to exceed in strength the usual or assigned pressure of the steam, but then boilers are liable to defects and deterioration, whilst the steam atmosphere is liable to agitation by suddenly opening or closing the passage to the cylinders or safety valves, and producing steam currents, with their culminating points of increased pressure. Suppose, for example, that a boiler is barely able to confine the steam safely, under the most careful working, the sudden opening of the safety valve, or regulator, would induce a rush of steam to that point, and produce greater pressure directly opposite that opening than on any other part. The pressure from each end of the boiler would compress, as in a slowly closed vice, the water immediately under the opening until the boiler was emptied or burst by the increased pressure of that compressed column of water. Practically, it is also found that a great number of explosions are traceable to such agitation, and the points of fracture to either the points of opening, or immediately opposite that point. Thus a boiler, if supposed only equal to sustain the steam in its ordinary state, the increased local pressure would produce rupture, and an explosion would take place with a force measured by the elastic power of the steam, and the expansive power of the water, into steam at the same instant. The nominal pressure of the steam would bear the same relation to its explosive force, as the ordinary atmospheric

pressure bears to its tempest force, since the explosive force of water is somewhat analogous to that of gunpowder, and the power of each is measured by the elastic expansion of the gases produced. The whole elastic and expansive force concentrated on one point, measures the explosive force in operation, and the amount of this force is evident by the distance to which its reaction against the part opposite to the fracture often carries the massive boiler, or destroys buildings.

An example will illustrate the extent of this force more clearly. Taking the "Lord of the Isles" locomotive, which attracted so much attention at the Exhibition of 1851, and the steam at 120 lbs. per square inch above the atmosphere, it gives an aggregate force of 17,438 tons, as calculated from the surfaces it acts against within the boiler.

Thus, the pressure on the cylindrical shell round the tubes,	=	1259·57	tons.
On the smoke-box tube plate, ...	=	90·53	"
On the fire-box and plate, ...	=	376·54	"
On the two outer sides of fire-box, ...	=	502·07	"
On the outer top plate of fire-box, ...	=	392·46	"
On the tube plate of fire-box, ...	=	95·10	"
Total pressure on outer shell, ...	=	2716·27	tons.
Pressure on the 303 tubes, each 2 inches in diameter,	=	13,569·87	tons.
Pressure on the inner copper fire-box, ...	=	1152·41	"
Total pressure as divided over the boiler, ...	=	17,438·55	"

Confined in about 205 cubic feet of space, of which about 42 cubic feet are filled with steam, and 163 cubic feet with water. This is the quiescent force under ordinary conditions, as it is confined in a space of about 205 cubic feet, but which on release seeks instantaneously to occupy a space of about 277,436 cubic feet, equal to atmospheric pressure, which gives some idea of the gunpowder-like expansion of steam and water in explosions. The steam expands with an elastic force equal to that of eight atmospheres, or say to 336 cubic feet, and the water to about 1700 times its own volume, or about 277,100 cubic feet, making a total volume of 277,436 cubic feet, into which they would expand at the moment of explosion. The steam produces only about $\frac{1}{825}$th part of the expansive force, so that the explosive force of the water is by far the most formidable element in all boiler explosions.

On examining the destruction produced by some such explosion as is here supposed, it would be assumed that steam of only 120 lbs. pressure could not have torn iron as a man could tear a piece of cloth, but that enormous pressure had been produced by some neglect, or other cause. As has been shown, the nominal strength of boilers by no means indicate their real strength; any weak point giving way, however slightly, would be acted on by the steam until the elastic strength of the iron was passed, when fracture would ensue by any sudden agitation in the boiler. The point of fracture once reached, the force to be dealt with is no longer that of the divided pressure of the steam, or even its concentrated pressure in the fracture, but the explosive force of the water bursting into steam of 1700 times its volume, all directed towards that fracture, with gunpowder-like force, and gunpowder-like results.

The calm ocean and the carefully-worked boiler are relatively comparative, whilst in like manner the agitatated ocean and irregularly-

worked boiler are both indicative of danger, for each is subject to local atmospheric disturbance, differing only in their sphere of action, yet singularly approximating in their destructive forces. Therefore, as in the ocean storms, only the best craft, under skilful mariners, can live; so with boilers, only the best boilers, under skilful guidance, can give reasonable grounds for safety. The explosive force of the water and steam in a boiler fully accounts for the greatest exhibition of destructive power which may follow any explosion, and the view of the subject will be illustrated by referring to a few examples, chiefly amongst locomotive boilers, as the field of the author's experience. The details of most of them will be found in the Government Railway Inspectors' reports, and other points mentioned were those noted by a personal inspection of several of them after the explosion.

1. The Clyde steamboat, the *Telegraph*, 1842. This was amongst the first of the locomotive class of boiler which burst, and caused so much discussion at the time. The usual pressure was 50 lbs. per square inch, and the steam had been turned on to start the boat, when a peculiar hissing noise was heard, followed by an explosion, which projected the boiler about 60 yards from the vessel. The boiler was on Bury's plan, and the top of the inner iron fire-box was fractured, and exhibited an originally laminated plate, with several blisters on it. It was also stated that it had been twice burnt previously—that is, exposed to the fire without being covered with water, which probably caused the blisters, and greatly increased the original defect.

Here, then, the local defect, the local agitation by turning on the steam, the hissing of the breaking iron, the fracture, and the projectile force, are all distinctly attested, and all compatible with quiescent pressure of 50 or 60 lbs. per square inch suddenly expanding to an atmospheric pressure, and acting on one point, whereby the reaction threw the boiler out of the boat into the water.

2. The "Irk" locomotive boiler, 1845. This explosion took place in the shed at Hunt's Bank, after the driver and fireman had got on the engine to take it out on duty; and as they were both killed, it is not known exactly whether the safety-valve had been tried, or the regulator opened, or not. It is, however, so usual to do one or the other, or both, in such circumstances, that it is highly probable that at least one of them was opened. As it was, the top of the inner fire-box was forced down; the brick-work of the shed under the fire-box was also forced down several inches; the engine, about 20 tons, raised through the roof, carried about 14 yds., and turned end over. The strong connexion with the tender was broken, and it was also turned end over.

There is, therefore, the probable local disturbance of the steam atmosphere; the local fracture, and explosive force, also, in this instance. Indeed, the local action is very distinctly remarked, as confined between the brick-work as an abutment, and the top of the outer fire-box as the centre of a projecting force, so excessive on that point as to break the strong connexion to the tender, turn the tender end over, raise the engine a considerable height through the opposing roof, and land it at 14 yards distance, after having made a complete somersault, by the local reaction of the force on the heaviest end, opposite the fracture.

To be Continued.

For the Journal of the Franklin Institute.

On taking Daguerreotypes without a Camera. By J. F. Mascher.

To the Committee on Publications.

The accompanying stereoscopic pictures were taken by me, by means of a box (to be described hereafter) that contained neither lenses, reflectors, or in short any refracting or reflecting medium of any kind. I accidentally made the discovery that photographic pictures could be taken in this manner while prosecuting some experiments relative to stereoscopic ANGLES.

It is well known that two pictures taken with two ordinary cameras placed only $2\frac{1}{2}$ inches apart horizontally, will not when placed in the stereoscope show proper or sufficient stereoscopic RELIEF, yet it is well known that the human eyes are only placed $2\frac{1}{2}$ inches apart, yet are enabled to see solid objects in their proper solidity and relief; and to explain the why and wherefore of these facts has challenged the attention of Professor Wheatstone, Sir David Brewster, and a host of others, leading the above named gentlemen into a very sharp controversy, leaving the main question, the determination of the proper stereoscopic angles, as far as practical results are concerned, in precisely the same condition in which they found it. Under these circumstances we may be permitted to ask, why is it that two pictures, taken by two cameras placed $2\frac{1}{2}$ inches apart, do *not* show sufficient stereoscopic relief? Why is it that we must place the cameras about eight times farther apart than the human eyes are in order to produce the proper relief? When these questions first suggested themselves to me, the following answer occurred to me without at that time being able to prove it to be the correct one; namely, because the lenses in the cameras ($\frac{1}{4}$ size) are twelve times larger than the human lenses (eyes).

In order to ascertain whether this is the correct answer or not, it was only necessary to take two pictures with two cameras having a diaphragm in each, the opening in which are $\frac{1}{8}$ of an inch in diameter, that being the diameter of the diaphragm in the human eye. In executing this experiment, I was very much surprised to find that the focal RANGE of the camera was increased to an extraordinary extent. The cameras had been focussed for a house on the opposite side of the street, but the moment the diaphragm was introduced, the sash in the window, which before was invisible, suddenly became as sharp and distinct as the house on which the focus had been previously drawn. Subsequently, on removing the camera to an upper story of my house, it was found that this increase in focal range extended not only from the house towards the camera, but to an equal extent beyond the house. After ascertaining these facts, it became desirable to find out the cause of them. With this end in view, the lenses were removed from the tube, and only the diaphragm remained in the same. You may well imagine my astonishment at finding the pictures of houses and other objects in the street faithfully depicted upon the ground glass! the letters of signs, &c., reversed, precisely as if the lenses had been used. The next step was to ascertain whether these pictures possessed photogenic properties, which was soon done by substituting a metal diaphragm with an apperture of $\frac{1}{50}$ of an inch in diam-

eter for the paper one of $\frac{1}{8}$-inch in diameter, putting in a coated plate, leaving it remain 15 minutes, coating it in the usual manner, and a beautiful picture similar to the one herewith sent was the result.

It was self-evident now, that we had the means to do that with one camera, for which two were before deemed indispensable, namely, taking two stereoscopic pictures through two apertures situated only $2\frac{1}{2}$ inches apart. But as a quarter size plate is only $4\frac{1}{4}$ inches long, and as it was desirable to take the two pictures on one plate, two apertures $\frac{1}{66}$ of an inch in diameter were made in the metal plate above alluded to, only $2\frac{1}{4}$ inches apart, and after twenty minutes exposure, the sun shining on the house all the time, the accompanying pictures were the result, thus demonstrating conclusively that two stereoscopic pictures can be taken on one plate with one camera (or dark chamber without lenses) and simultaneously, without either reflectors or refractors of any kind whatsoever!! It may here be remarked, however, that the pictures thus taken on one plate are stereoscopic reverse, that is to say, the right picture is on the side where the left one ought to be, and vice versa, which can, however, be very readily remedied by cutting the plate in two and pasting them together again properly. This stereoscopic reverse was next attempted to be remedied by placing a reflector before the apparatus, but the only effect produced by this device, was the same as the same reflector produces upon pictures taken by an ordinary camera, namely, making the pictures appear in their natural position, so that letters on signs, &c., could be read correctly.

There is another advantage resulting from this camera; it is this. You may make two, four, six, or more sets of holes in the same camera, either all of the same diameter, by which means you will obtain an equal number of stereoscopic pictures with the number of sets of holes, or you may make one set with apertures of $\frac{1}{200}$ of an inch, another $\frac{1}{100}$ of an inch, one set $\frac{1}{70}$ of an inch, and still another set with $\frac{1}{25}$ of an inch in diameter, where you will be certain to obtain at least one set of pictures properly "timed," especially as the other pictures which are not properly timed can be rubbed out before gilding, thus saving the plates.

So much for the actual experiments. Let us see what practical conclusions can be derived from them.

They teach us that a theoretical eye occupies no more room than a *mathematical point*. Secondly, the diaphragm in the human eye is $\frac{1}{8}$-inch in diameter. Thirdly, that the lenses commonly employed in taking photographic pictures vary from $1\frac{1}{2}$ to 6 inches in diameter.

What is the theoretical difference between these three kinds of eyes? What the practical difference?

A board one foot square, placed 5 feet distant before a theoretical eye, will obscure or eclipse a space of 576 square inches of a back ground, situated 10 feet from this eye. The same board, under the same circumstances, placed before the human eye, will obscure only 564 square inches! Whereas, if it be placed before a $\frac{1}{4}$ size camera, under like conditions, it will only obscure 495 square inches!! A double whole size camera, with lenses 6 inches in diameter, will merely obscure 324 square inches. From this it is apparent, that a picture, taken with a camera, with lenses larger than the human eye, will show more of the object

than what the human eye, placed in the same position, will be able to see. A man can place one of his eyes in such a position, that he can see only one ear and the greatest portion of the face of a person. A camera, placed in precisely the same position, will take a picture in which not only all the objects which the human eye had previously seen, but also the other ear will be clearly delineated! Such pictures are anti-stereoscopic; distortions; disfigurations intolerable in proportion to what the lense, with which it is taken, exceeds in diameter the size of the human eye. Such pictures will do for owls to look at! The back and (to the eye) invisible parts of an object are brought out by such large lenses, as prominent as the natural prominent portions of such objects themselves, and producing by their contrast, flat and inanimate pictures, giving to the face, &c., of the subject a broader, longer, and fuller appearance than they appear to a single human eye. We might with the same propriety call the hide of an ox, when spread upon a flat surface, a portrait of that animal, as to call a picture, taken in a camera with such large lenses, a portrait of the "human face divine." Who has failed to notice the immense difference between the large (" the splendid gilt frames!") so called portraits, both on paper and plate, in Broadway, Chestnut, Washington, and Baltimore streets, and the small miniature likenesses frequently met with in medallions, charms, breast-pins, &c., taken with a good small locket camera. The one looks flat, distorted, and inanimate; the other appears to stand and project right out from the plate, ready as it were at a moment's calling to leap into existence as a living being. So much for single pictures. Let us examine double or stereoscopic pictures.

From what has been said, it will be easy to understand how it is that two pictures taken at an angle no larger than that of the human eyes do not show sufficient relief; for if it be true that each individual picture is more flat than the same object appears to a single eye, then it is also true that the two pictures, when combined in the stereoscope, will present less relief than what two similar pictures would do, that were taken by means of lenses only $\frac{1}{8}$-inch in diameter, or the same size of the human eye.

In the human eye we find, as in all other parts of the body, the most extraordinary wisdom displayed, and it is only the hand of Omnipotence that could have designed and constructed such a wonderful organ. Not only do we find a single eye perfect in all its parts, but we also find the two eyes arranged in such a manner as to give the greatest possible amount of effect to binocular vision. Who can devise anything better? To imitate and equal, it ought to challenge our undivided attention.

Who ever saw an animal with two eyes each six inches in diameter and 16 inches or two feet apart? Or who, two small ones forming an angle with the horizon of 45°? My friends in Boston will please forgive me, as I design them no intentional harm.

But what is the difference, it may be asked, if we can compensate, by simply moving the cameras a little further apart, for the deficient stereoscopic relief? To which I answer, that we can indeed make such compensation, but it is always at a little expense of the truthfulness of the picture. Others will no doubt have noticed, as I have done, the great

apparent *shift* of positions of prominent objects in some modern stereoscopic pictures. These prominent objects in the left picture will be found thrown, as it were, to the right; whereas in the right picture they will be found to the left, straining the eye, in some instances very much, in endeavoring to coalesce them. This is especially true with regard to groves of trees, &c. This difficulty is not experienced when looking at the objects themselves, *nor when looking at pictures of such objects when taken*, as the one above alluded to, *through two small apertures only* $2\frac{1}{4}$ *or* $2\frac{1}{2}$ *inches apart.* And I have taken the picture of a street in which the most prominent object was only one foot from the camera (dark chamber) and the most distant one (Christ Church) at least one mile distant, yet not only were both in perfect focus (they could not be otherwise) but the eyes could also see them in the stereoscope in their proper stereoscopic relief, without experiencing the least contortion or fatigue.

In conclusion, I may say, that I think I have proven the superiority of small over large lenses in photography. We can now see that we need not look to the increase in size of the lenses, in our cameras, for the production of large photographic pictures that will at all be entitled to be called correct portraits, but that we must look to the perfection of small lenses, as well as to the quality of the chemicals employed. We want chemicals that will work instantaneously, even with small lenses. The human eye produces instantaneous pictures!

I would suggest a mode of assisting the quick action of small lenses. I would set the subject in the open air; take advantage of all the light that can be obtainad. Who will be the first to build a skylight room, with the roof and walls removed?

Philadelphia, March, 1855.

Gas and Oil from Vegetable Substances. J. H. Johnson, London and Glasgow.—Patent dated January 30, 1854.*

This invention has been communicated to the patentee by MM. Kœchlin, Duchatet, and Perpigna, and is patented in this country on their behalf. It relates to certain modes of producing gas for the purposes of heating and lighting, from turf, wood, tar, and the waste or refuse of various vegetable substances, such as cotton, paper, chips, saw-dust, and other similar articles.

For effecting the production of gas from turf, it is merely necessary to place the dry turf in a gas retort and heat it to a red heat, but this gas has very slight illuminating properties. It burns with an almost entirely blue flame, and is altogether totally inapplicable to lighting purposes. Various means have been adopted for carbonizing this gas, but these have hitherto been found inapplicable in practice. The obviation of these difficulties hitherto met with forms one of the main features of the present invention. The operations, which can never be satisfactory if effected at one time, are divided into two distinct processes, and the carbonization of the turf or peat is conducted so as to produce the best

* From the Lond. Pract. Mech. Journ., Feb., 1855.

result, both as regards the quantity and quality of fuel, whilst, at the same time, the admixture of an injurious material (oxide of carbon) with the gas for lighting purposes, is avoided. The decomposition of the essential oils of turf or peat is effected, not so much by the superheating of the oils themselves (for which by nature they are not adapted,) but by causing their vapors to make a long circuit through pipes or vessels, heated to a temperature sufficiently great to effect their decomposition and conversion into gas. It is proposed either to mix the gas thus produced by the two operations, so as to obtain a moderate lighting power, or to employ them separately; the first for heating purposes, as will be hereinafter described; and the second for illuminating purposes, being of a superior richness.

The same processes are also equally applicable to the conversion of coal tar into gas. This decomposition and conversion into gas is effected by causing the tar to pass in a state of vapor through the heated passages before referred to. But it is necessary in this case to use particular care on account of the peculiar chemical nature of the material under treatment. The tar obtained from gas works is a composition of fine or well divided coal, agglomerated by essential oils of different degrees of weight and volatility. If the tar is caused to pass directly over heated surfaces, the essential oils are decomposed, and the coal, freed from this species of cement, which held it together, resumes its state of impalpable tenuity, and is drawn by the current of gas into the pipes, these becoming eventually obstructed thereby, the operation being consequently stopped by reason of the great deposit of coal dust in the pipes. This difficulty is easily obviated by introducing the tar (as free from water as possible) into a still or sheet iron retort, similar to those at present employed in the preparation of coal oils. The process of distilling effects the separation of the vapors of the oil, which disengage themselves from the coal which rests in the retort, the latter forming the product known as dry resin, which may be employed as fuel. On leaving the retort, the vapors of the oil, in place of entering a worm to become condensed and form the oil of coal, are passed over a heated surface, as hereinbefore described. In passing along these heated surfaces, the vapors are converted into gas by the action of the heat, and as the particles of coal have been previously separated or removed, the obstruction to the pipes hereinbefore described will be avoided.

Fig. 1, of the accompanying engravings represents a longitudinal vertical section of a retort, in which the carbonization of turf is effected, and fig. 2 is a transverse section of the same. The roof of the retort is of cast iron, and is either elliptical or circular; internal flanches are cast upon the roof, and upon these flanches is supported the bottom of the retort, which is composed of fire clay tiles, luted to each other and to the retort with clay. The waste or refuse of the coal which results from the operation will complete the luting, and effectually prevent any escape or leakage. Lugs are also cast upon the roof, outside the fire clay brick-work. These lugs are united by the transverse tie rods or bolts, which maintain the proper width of the retort, and serve, at the same time, to strengthen and bind together the brick-work. The peculiar construction of this compound retort of fire-clay and cast iron forms an essential fea-

ture of this invention, and offers many advantages. The fire clay bottom of the retort resists better than cast iron the high temperature attained at the termination of the operation, and as its expansion is allowed for,

Fig. 1.

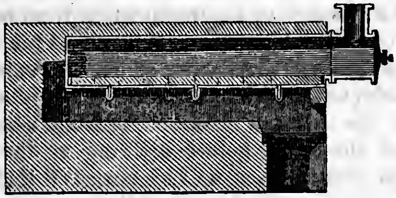

Fig. 2.

it is not exposed to the inevitable fracture to which retorts composed entirely of fire clay are subjected by the changing of temperature. The same liberty of contraction and expansion enables also the cast iron portion of the retort to resist the destructive changes of temperature, and, at the same time, permits the heat from the fire bricks to enter the interior of the retort. This retort is placed in a furnace, which is so arranged, by the aid of flues, that the whole surface of it may be equally heated. The retort is connected with an ordinary retort head fitted with pipes for the disengagement of the vapors. The vapors enter a refrigerator, which may either be of the form of a worm, or still better, similar to the air condenser generally employed. In this condenser is effected the condensation of the ammoniacal waters, and the oils which are collected separately. The non-condensable gas passes off to the gasometer, previously traversing, however, through lime purifiers.

Fig. 3 of the engravings represents a longitudinal vertical section of an apparatus for effecting the conversion of volatile oils into gas; and Fig. 4 is a transverse section of the same. A cast or wrought iron cylinder, A, which is partially filled with fragments of carbonized turf, receives the volatile oils by the syphon pipe, B, which is itself supplied by a pipe communicating with an upper reservoir or vessel, and fitted with a cock,

Fig. 3.

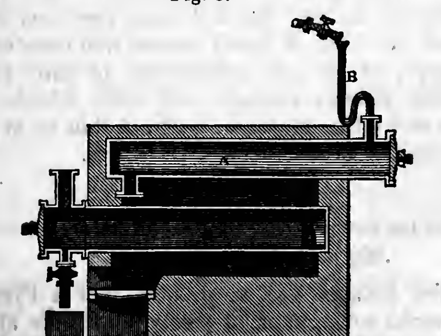

Fig. 4.

by means of which the flow of oil may be regulated. The entire apparatus is placed in a furnace and heated equally over its whole surface. As fast as the oil enters the cylinder A, it is evaporated, and passes in the state of vapor to the pipe, C, which communicates with the retort, D.

This retort, which is of cast iron, and of the same length as the cylinder, A, is divided longitudinally into two distinct chambers by a partition, which is cast in one piece with the body of the retort, and extends from the front end of the same to within a short distance of the other extremity, so as to afford a passage or communication from one chamber to the other between the end of the retort and the end of the partition or diaphragm. By this arrangement the vapors of the oil enter near the end of the retort on one side, and pass along the entire length of the same through the opening into the second chamber, passing a second time along the entire length of the retort before arriving at the exit pipe. From the arrangement just described, it will be observed that the vapors have to traverse nearly three times the length of the apparatus, and they are subjected during their passage to a heat sufficiently great to cause the decomposition required. A small pipe fitted to the under side of the retort head allows of the withdrawal of the non-vaporized oil, or the vapors which may have condensed in the exit pipe. The oil thus drawn off is replaced in the upper reservoir or supply vessel, and again passed through the apparatus. The pipe, E, communicates by a dip pipe, as in the ordinary arrangement of gas apparatus with a receiving cylinder partially filled with water. From this cylinder the gas passes into a condenser, which effects the separation of any particles of oil which may not have been decomposed. This oil is also reconveyed to the supply reservoir or tank, to be again passed through the apparatus. From the condensers the gas passes to the lime purifiers, and thence to the gasometers, where it is mixed with the gas produced from the carbonization of the turf. We have as yet described only one application of the essential oils derived from carbonized turf—namely, their conversion into gas; but as in order to render this gas sufficiently powerful for lighting purposes only ten or fifteen per cent. of the oil is required, and as the turf supplies twenty-five or thirty per cent. of such oil, it follows that there will be a considerable quantity remaining. By this means the price of the gas will be considerably reduced, as the purposes to which the remaining oils may be applied will bring in a considerable revenue. The patentees further specify modes of making the following products from the oil hereinbefore referred to:—1st. A liquid almost free from odor, suitable for burning in lamps, or for the manufacture of hard varnish. 2d. Grease for lubricating railway carriage and other wheels. 3d. Hard soaps for the toilette and other purposes. 4th. A thin oil of fine quality, suitable for lubricating the most delicate mechanism.

For the Journal of the Franklin Institute.

Magnetic Water Gauge.

We learn from the *Cosmos*, Vol. v. p. 630, that a Frenchman, M. Lethuillier Pinel, special constructor of safety apparatus at Rouen, has invented a water gauge which has very great advantages, and is "founded on a very simple and ingenious principle which had never yet been applied to this use." The description is of a blundering modification of Faber's magnetic gauge. It has been favorably reported on to the Society for the Encouragement of National Industry.

Really the ignorance (real or affected) of these men who cannot be made to know anything which takes place out of their own city or country renders them unfit to express an opinion on a mechanical invention. One would think that French industry might be better applied than in pilfering inventions from others. We refer *Abbè* Moigno, to Vol. XXI, Third Series, p. 215, of our Journal, (March, 1851,) for the very superior original form of the instrument to which he dedicates so much space, but not more than its utility and the ingenuity of the true inventor, Mr. Faber, deserves. F.

For the Journal of the Franklin Institute.

On transmitting two Messages at the same time in Opposite Directions by the Galvanic Telegraph.

Considerable attention has been excited in our Journals, by the announcement that Dr. Gintl, Director of the Austrian Telegraphs, had succeeded in sending two messages at the same time in opposite directions through the same wire between Lintz and Vienna. The *Cosmos*, Vol. v, p. 688, contains some account of this experiment from a communication by M. Zantedeschi, from which it would not appear that there was any sufficient evidence of this fact. The experiment of M. Zantedeschi in confirmation, is, as M. Moigno remarks, entirely fallacious. There can be no difficulty in imagining two pulsations or waves of electricity to pass each other on a wire as two waves may be seen to do in water, but whether it has been done, is, as yet, questionable. F.

On the Applicability of Gelatine Paper as a Medium for Coloring Light.

By Horace Dobell, Esq.*

The object of this communication is threefold.

1. To point out the properties of a material called Gelatine Paper, which render it applicable as a medium for coloring light.
2. Through the means of gelatine paper, to introduce the use of colored light in the arts for the preservation of the sight of artisans.
3. To introduce the use of gelatine paper for the relief of persons suffering from impaired vision; for the preservation of the sight of travelers, and of all those who are much engaged in reading.

This material was invented in 1829 by the late M. Grenet, of Rouen, and was exhibited by him in its present state of perfection at the Great Exhibition of 1851. But up to the present time it has not been successfully applied to any more useful purposes than the manufacture of artificial flowers, address cards, tracing paper, wafers, wrappers for confectionary, and the like.

It is commonly manufactured in sheets, measuring 22 inches in length and 16 inches in diameter, which are sold at a small price; but the sheets can as easily be made of any dimensions not exceeding those of which plate-glass is capable. It can be made of any thickness, from that of the finest tissue paper upwards. It may be obtained as transparent as the best glass, and more free from color, or of all colors and shades of color, without interfering with its transparency. It is exceedingly

* From the Lond., Edin., and Dub. Philos. Mag., Feb. 1855.

light, and may be bent or rolled up without injury. It can be cut with scissors like ordinary paper, and may easily be stitched with a needle and thread. By means of an aqueous solution of gelatine, it can be made to adhere accurately to plates of glass without any interference with its transparency. When varnished with collodion it becomes perfectly waterproof, more pliable, capable of bearing a considerable degree of heat without injury, and its transparency is not affected.

Hence it appears, that, in addition to its transparency and susceptibility to various colors and forms, gelatine paper is cheap, portable, and durable.

Such being the properties of the material, the following are enumerated by the author as some of the forms in which he suggests that it may be employed, and in which it has already been found useful.

1. A small sheet of very pale green or blue gelatine paper, to be used in reading. The sheet is simply to be laid upon the page of the book, and the reading to be conducted through the colored medium. If used in a faint light, the reading paper is to be raised a little from the book to admit more light beneath it.

2. A sheet of gelatine paper of pale green set in a light frame, and placed like a screen before the window or lamp of the engraver, the watch-maker, the jeweller, and the like; thus providing a light of genial color in which they may pursue their occupations.

3. A similar appliance to the last mentioned for the use of needle-women. For this purpose screens are to be provided, both of green and of blue gelatine paper; so that the white materials employed in needle-work may be changed to a pleasant green, by the screen of that color, the yellow materials to a green by the blue screen, and by one or other of these screens the reds softened down into violets or browns.

4. For either of the two last purposes on a larger scale, the gelatine paper may be attached to the window glass of the apartment, thus coloring, if necessary, all the light admitted during day-light.

5. Shades for the eyes in certain affections of the sight, to take the place of the green or blue silk and card shades worn by many persons. The gelatine paper being transparent, will allow the wearer to see his way about, at the same time that the eyes are protected from a glaring light. This may be especially useful in cases where it is desired not only to shade a diseased eye, but also to protect its nerves from strong light admitted by the sound eye. When not only colored light but a certain degree of darkness is required, this can be readily and delicately graduated by employing shades of different depths of color.

6. Masks of gelatine paper for protecting the eyes of travelers against the glare of snow fields and of sandy deserts.

On some of the Thermo-electric Properties of the Metals Zinc and Silver. By Richard Adie.*

A zinc and silver thermo-electric couple is known to reverse the direction of the current of electricity generated by heating it, when the temperature of the joint is raised above 248°, as described by the late Professor Daniell in his Introduction to Chemical Philosophy, p. 468. This

* From the Lond. Journ. of the Chemical Society, Jan. 1855.

peculiar property I have made the subject of the following experiments, which I hope may prove interesting, for they show how completely thermo-electrical currents are governed by resistance to conduction in the joints of the couples.

Experiment I.—A piece of zinc wire was soldered to a piece of silver by pure bismuth for a solder, and the joint was made strong with a large surface of bismuth in contact with the metals. On heating this couple by dipping the joint in oil raised to different temperatures, the reversal of the current alluded to above was observed; for temperatures under 250°, zinc was positive, and for temperatures above that point, silver was the positive element.

Experiment II.—The same zinc and silver as in the last experiment, with bismuth surface in contact with the metals, made as small as practicable. The heat was applied by dipping the joint in oil raised to various temperatures from 100° to 360°, and in all, the silver was the positive metal. The peculiar property of the reversal of the current, as the temperature passed a certain point, had disappeared with a change in the joint, which had only increased its resistance to conduction.

Experiment III.—The same zinc and silver couple employed with a joint formed without solder. The two surfaces of the metals were cleaned, and bound firmly together with thread, with only small portions of each element in contact. The result of this experiment was the same as No. 2; the silver stood positive for all temperatures.

Experiment IV.—The same zinc and silver were joined by a bismuth soldering, so as to form a continuous straight wire, with a bismuth joint in it, of which the surface in contact with the metals was nearly equal to the section of the wires. When heat was applied to the zinc wire, about two-tenths of an inch from the joint, silver was positive for all temperatures. And when heat was applied in a similar manner to the silver wire, the zinc became the positive metal for all temperatures. In this experiment, *the direction of the flow of heat across the joint governed that of the thermo-electric current generated;* it is a result which I have met with in many other thermo-electrical couples tested in like manner.

Experiment V.—A piece of zinc wire cut in two halves formed the couple for this experiment, with the joint formed by tying them firmly together; for temperatures under 300°, this arrangement showed very slight thermo-electrical effects; for higher temperatures more decided evidence of electrical action was obtained, but the direction of the currents generated was not regular.

Experiment VI.—The same pieces of zinc as for the last experiment, No. 5, with a bismuth joint, formed in the same manner as for experiment No. 4. This formed a delicate thermo-electrical couple. When the right side of the joint was heated, the left wire was positive; and when the left side was heated, the right became positive; these effects could be readily shown by grasping the wires in the fingers. A similar experiment was made with a silver wire cut in two.

Experiment VII.—A piece of silver wire and a bar of bismuth formed the couple for this experiment. It may be premised that bismuth is a metal strongly positive to every other, and that the object in view was to endeavor to exhibit it as a negative element. For the joint, the point

of the silver wire was heated in sulphur until it was thickly coated with a sulphide of silver, and the sulphuretted portion was tied firmly down to the bismuth. On heat being applied to the silver, the couple did not become active* till the temperature was near 400°, when the bismuth showed itself the positive metal. On heat being applied to the bismuth bar, near the joint, the couple became active as before, at a high temperature, *and silver stood as a positive thermo-electric element to bismuth.* The experiment was tried with a thin coat of sulphide on the silver, when the couple became active at a lower temperature; but bismuth then stood positive to silver when heat was applied on its side, as well as when heat was given on the silver side.

Experiments like these, showing the direction of thermo-electrical currents to be under control, can be multiplied in great variety.

On the Formation of Brass by Galvanic Agency.†

Copper is more electro-negative than zinc, and separates more easily from its solutions than a metal less negative. If, then, in order to obtain a deposit of brass by galvanic means, we employ a solution containing the two component metals, copper and zinc, in the proportions in which they would form brass, there will only be produced by the action of the battery a deposit of real copper: the zinc, more difficult of reduction, remains in solution. What must be done, then, to obtain a simultaneous precipitate of the two metals in the proportions required, is either to retard the precipitation of the copper, or to accelerate that of the zinc. This may be effected by forming the bath with a great excess of zinc and very little copper.

Dr. Heeren gives the following proportions as having perfectly succeeded:—

There are to be taken of	Sulphate of copper, .	1 part.
	Warm water, . . .	4 parts.
And then	Sulphate of zinc, . .	8 "
	Warm water, . . .	16 "
	Cyanide of potassium, .	18 "
	Warm water, . . .	36 "

Each salt is dissolved in its prescribed quantity of water, and the solutions are then mixed; thereupon a precipitate is thrown down, which is either dissolved by agitation alone, or by the addition of a little cyanide of potassium: indeed, it does not much matter if the solution be a little troubled. After the addition of 250 parts of distilled water, it is subjected to the action of two Bunsen elements charged with concentrated nitric acid mixed with one-tenth of oil of vitrol. The bath is to be heated to ebullition, and is introduced into a glass with a foot, in which the two electrodes are plunged. The object to be covered is suspended from the positive pole, whilst a plate of brass is attached to the negative pole. The two metallic pieces may be placed very near.

The deposit is rapidly formed if the bath be very hot: after a few minutes there is produced a layer of brass, the thickness of which augments rapidly.

Deposits of brass have been obtained in this way on copper, zinc,

* A delicate galvanometer showed no indication of the passage of an electrical current.

† From the London Artizan, February, 1855.

brass, and Britannia metal: these metals were previously well pickled. Iron may, probably, also be coated in this way; but cast iron is but ill adapted for this operation.—*Mittheilungen des Hannov. Gewerbevereins,* through *Bulletin de la Société d'Encouragement, No.* 16, *August,* 1854.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, April 19th, 1855.

John C. Cresson, President, in the chair.

John Agnew, Vice President,
Frederick Fraley, Corresponding Secretary, } Present.
Isaac B. Garrigues, Recording Secretary,

The minutes of the last meeting were read and approved.

Letters were read from the Regents of the University of the State of New York, and Uriah A. Boyden, Esq., Boston, Massachusetts.

Donations to the Library were received from the Royal Astronomical Society, and the Statistical Society, of London; Col. J. J. Abert, Chf. Corps Top. Engrs., and Prof. A. D. Bache, Super. Coast Survey, Washington City, D. C.; Wendel Bollman, Esq., Baltimore, Maryland; John S. Dodge, Civ. Eng., Rome, New York; Aug. F. Dalson, N. York; Jas. B. Francis, Civ. Eng., Lowell, Mass; and Prof. J. A. Kirkpatrick, Dr. T. S. Kirkbride, James H. Bulkley, Dr. Charles M. Wetherill, Parry & McMillan, Uriah Hunt, and Geo. M. Conarroe, of Philadelphia.

The Periodicals received in exchange for the Journal of the Institute, were laid on the table.

The Board of Managers and Standing Committees reported their minutes.

The Standing Committee on Exhibition presented a printed copy of their report on the last Exhibition.

The Treasurer read his statement of the receipts and payments for March.

The candidates for membership in the Institute, (6,) were proposed, and the candidates proposed at the last meeting, (5,) were duly elected.

The Corresponding Secretary stated that Prof. Frazer was on the eve of going to Europe, to be absent for several months, and offered the following resolution, which was adopted, viz:

Resolved, That the Institute do most cordially commend Prof. Frazer to the confidence, attention, and respect, of their foreign Associates and Corresponding Societies, and ask for him such introduction to men of Science, and to the Cabinets and Libraries of Europe, as may be in their power to afford.

On motion, the Corresponding Secretary was instructed to present the thanks of the Institute to Uriah A. Boyden, Esq., of Boston, Mass., for his donation of One Hundred Dollars, presented in his letter read this evening.

Dr. Rand exhibited a model of "Atkins' Self-Acting Automaton Reaper." This invention has been reported upon by the Committee on Science and the Arts, and the report published in the *Journal,* Vol. XXVIII, Third Series, p. 144, August, 1854.

Washington Jones presented to the notice of the members, the model

of a Steam Cylinder Piston, designed by Messrs. Morris, Tasker & Morris. One on the same plan has been used by them with a satisfactory result. No springs or set screws are required to keep the packing rings in contact with the surface of the cylinder, the adjustment being made in this way: a ring of metal with an exterior diameter somewhat less than the bore of the cylinder, and having its outer part turned so that it forms a double truncated cone, placed base to base, serves as the setting out piece. To give it elasticity, a piece is cut from it, say one-quarter of an inch in length, the two ends standing apart that distance when the ring is subjected to no strains. The outer part of the ring is removed to a certain depth by concentric saw cuts occurring at regular intervals; this is for further increasing the elasticity. The packing rings are fitted one on either side of the setting out ring; the surfaces in contact conforming in shape. As the rings wear, they are pressed out by tightening up the follower bolts, which forces the rings towards the bases of the truncated cone, formed by the middle, or setting out ring, thus increasing their diameter, a long diagonal cut being made in the packing rings to allow for their expansion.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on Andrew Mayer's Gas Nipples.

The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a "Self-regulating Gas Nipple, to govern the flow of Gas to burners," invented by Mr. Andrew Mayer, of Philadelphia, Pennsylvania—REPORT:

That this regulator is formed from a cylindrical block of brass or other suitable metal $1\frac{1}{8}$-inch long and $\frac{9}{16}$ths diameter; the upper $\frac{5}{16}$ths is turned down and has chased upon it a thread to receive the burner; the lower end is drilled $\frac{1}{2}$-inch deep and $\frac{5}{16}$ths diameter, and has chased within it a female thread to fit the supply pipe. From the lower end a drill $\frac{1}{4}$-inch diameter is run in $\frac{5}{16}$ths beyond the thread to form a cavity and seat for the reception of a valve. From the upper end of the block a drill $\frac{1}{8}$-inch diameter is run through into the valve chamber, and this hole is reamed out to $\frac{1}{4}$-inch diameter at the top end, tapering to $\frac{1}{8}$-inch at its entrance into the valve chamber. The seat for the valve is then perfected with a drill suitably beveled run in from the bottom of the block. The valve is of a conical form $\frac{1}{4}$-inch long and scant $\frac{1}{4}$-inch diameter at the lower end. It is made by stamping from thin sheet brass, and consists of three triangular leaves united at their apices; these leaves are rounded up in a mould so that their edges overlap slightly, and the apex of the cone is pierced by a small opening varying in different regulators from $\frac{1}{50}$th to $\frac{1}{70}$th inch diameter. The burr formed by drilling is allowed to remain, and is of material assistance in adapting the flow of gas to the requirements of the burner employed. The lower end of the valve is open, and the lower edge is left irregular, so as to allow of the passage of a considerable amount of gas when the pressure is low and the valve consequently resting upon the bottom of the chamber.

The average weight of the valve used with the ordinary union jet consuming four cubic feet of gas per hour, is one grain. To retain the valve in its chamber, use is made of a metallic cup perforated by a hole $\frac{1}{16}$-inch diameter; this is forced into the bottom of the chamber, and forms a rest for the valve when down from its seat, and allows a play of about $\frac{1}{16}$th of an inch.

The object of this regulator is to equalize the supply of gas to the burner. In all ordinary gas mains the supply of gas to individual burners is continually varied by variations of the number of lights receiving gas from them, and as every burner has some particular stage of consumption at which it gives the greatest light for its expenditure of gas, it is important to maintain that condition as nearly as possible. This is partially done by the governors usually placed upon the large supply mains at the points of supply. But the influence of local causes cannot be overcome except by carefully adjusting the supply to each burner, and as this becomes a matter of much trouble when done by hand, many devices have been contrived to approximate the adjustment mechanically. Among the first of these regulators were miniature governors, similar to those used by gas works upon the great mains, placed upon each service pipe near the metre. These were perfect adjusters so long as care was taken to regulate the burners, or the supply to each burner individually, by plugging it in such way as to ensure its proper action at some fixed pressure. But the want of this knowledge and the extravagant prices demanded for them by the makers have prevented their general use.

Regulators for individual burners were then introduced, but as any apparatus depending upon the pressure of the atmosphere was considered too cumbersome and expensive to be multiplied in the same degree as the burners, other means were employed to adjust the flow of gas. The principle generally employed is that of producing a greater or less amount of friction by causing the gas to flow through smaller or larger orifices in the supply pipe in proportion as the pressure became more or less. The most favorite form of apparatus is a cylindrical chamber in the lower part of the burner, in which is placed a circular plate or plates of metal perforated in the centre with a hole large enough to allow the passage of the proper amount of gas at the higher pressures, and the plates light enough to be raised to the top of the chamber by the friction of the gas passing through the central opening. The plates having a burr or other roughness upon the lower edge, raising them slightly from the bottom of the chamber, and allowing an amount of gas to pass beneath in addition to that passing through the centre opening when the pressure was insufficient to raise the plate. This regulator should be so adjusted, that the plate remains stationary at the bottom of the chamber until the passage of gas just exceeds the maximum required for the proper consumption in the burner, at which point the plate would be lifted against the top of the chamber by the friction of the passing gas, and the supply restricted to the amount capable of passing through the central opening, which should be sufficient to supply the burner at a point slightly below the maximum. The objections to this instrument are the small range of pressure ($\frac{6}{10}$) that it adapts itself to, its liability to catch against the sides of the chamber from its form, and the liability to adhere to either extre-

mity of the chamber in consequence of the deposit of any oil or tar upon its extensive surface in contact with them.

A later regulator claims for its efficiency the inertia of the gas. In this contrivance the gas is introduced to the burner through narrow passages of a tortuous form, and is also compelled to pass through a series of openings. It is claimed that the sudden change of direction retards the gas in proportion as the pressure tends to increase the velocity. In comparative experiments it has been found that the change of direction produces no appreciable effect; and that practically, similar results may be obtained by simply obstructing the supply pipe with a plug of wood pierced with a small hole or holes of sufficient area to pass the quantity of gas required for any given pressure. Mr. Mayer's regulator consists, as has already been stated, of a chamber containing a conical valve of extremely thin metal, and acts upon the same principle as the ordinary plate regulator, but according to the result of experiments tried upon it in comparison with all the others, it gives a much greater range of useful effect than any of them.

In performing these experiments, arrangements were made for ascertaining the pressure on both sides of the regulators, or in other words, the friction of the apparatus, upon the proper adjustment of which its efficacy depends. Comparisons were also made by suddenly increasing or diminishing the number of lights supplied by the same service, and the effect of gradual diminution and addition to the pressure, as also the effect of lights at different elevations upon the same service pipe. To obtain the friction of the regulators, gauges were attached to the supply pipe and also beneath the burner; the supply pressure was then varied from $\frac{1}{10}$th to $4\frac{5}{10}$ths by increments of $\frac{1}{10}$th, and the gauge beneath the burner noted for each variation. These comparisons were carried out upon over forty regulators, and the table marked A, exhibits the results in three cases, which are considered fair samples of the whole number. To obtain the effect of local changes, a service pipe of convenient length was prepared, having outlets for 24 burners. Upon these were placed 20 burners with Mayer's regulators adjusted in the usual way. One of Mayer's with friction gauges attached, and three other regulators, samples of the kind already described, also properly adjusted. The results are exhibited in the table marked B. The column *a*, shows the pressure upon the main service; *b*, the pressure beneath the burner with Mr. Mayer's regulator; *c*, the number of lights burning; *d*, *e*, *f*, the condition of the flame upon the other regulators.

The effect of the placing of one light above the other upon the same service was the addition of $\frac{1}{10}$th pressure for every 14 feet of height, and by partially closing the small hole in the point of the cone of the upper regulator in the manner employed by the inventor to adapt the regulator to the burner, similar results were obtained upon the pressure gauges under burners placed at very different altitudes. By examination of the results obtained, it appears that the relative ranges of useful effect rank in the following order:—

Mr. Mayer's regulator.	Other regulators.		
$(\frac{4}{10}\ a\ \frac{6}{10}\ a\ \frac{8}{10}\ a\ \frac{35}{10})$	$(\frac{20}{10}\ a\ \frac{34}{10})$	$(\frac{20}{10}\ a\ \frac{30}{10})$	$(\frac{10}{10}\ a\ \frac{15}{10})$
$\frac{29}{10}$ variation of supply.	$\frac{14}{10}$	$\frac{10}{10}$	$\frac{5}{10}$

The fractions within the brackets express the pressures upon the supply pipe. Those below them the range of useful effect.

An examination of the cause of the great range of useful effect produced by Mr. Mayer's regulator has led to the conclusion, that its continued efficiency after the pressure has caused the valve to rise, depends upon the fact that it consists of separate triangular leaves of very thin metal united by a small section at the top, affording a broad surface with long leverage (nearly the whole length of the valve) for the pressure to act upon and open out the valve to fit more neatly the sides of the chamber, and thus diminish the leaking between the sides of the cone and its seat; as the pressure diminishes, the spring of the metal causes the valve to resume its original form, and a still greater reduction of pressure finally allows the valve to drop, and permit the passage of gas around its periphery as well as through the centre opening. In conclusion, it may be stated that although this cannot be characterized as a perfect regulator, it appears to approximate to such more nearly than any other adapted to single burners.

To prevent misapprehension as to the utility of pressure regulators generally, it should be remarked, that where the burners in use are properly adapted to the quality of the gas and the pressure under which it is delivered, no advantage results from the use of a regulator; but as the great variety of burners in common use makes it impossible to adapt the street pressure to all, such a device becomes highly useful in conjunction with burners of least pressure, for which purpose the regulator under examination may with propriety be recommended.

Table A.

Pressures in inches of Water.				Pressures in inches of Water.			
On service.	On burners No. 1.	No. 2.	No. 3.	On service.	On burners No. 1.	No. 2.	No. 3.
·1	·1	·1	·1	1·6	·4	+ ·3	·35
·2	— ·2	— ·2	— ·2	1·8	·4	·35	— ·4
·3	·2	·2	·2				Best.
·4	— ·3	·3	·3	2·0	·5	+ ·35	·4
	Fair flame.	Best.	Best.		Best.		
·5	+ ·35	·4*	·4*	2·5	·6	— ·4	·5
·6	+ ·45*	+ ·2	·2			Best.	
·7	·3	+ ·2	+ ·2	3·0	·65	·4	·6
·8	·3	·25	— ·3	3·5	·7	·45	+ ·7
·9	·3	+ ·25	·3			Blowing.	Blowing
1·0	·3	— ·3	·3	4·0	·75	·5	·8
1·2	·35	·3	+ ·3		Blowing.		
1·4	+ ·35	·3	+ ·3	4·5	·8		

* Valve rose.

TABLE B.

a. Pressure on service.	*b.* Burner pressure.	*c.* Number of lights burning.	State of flame above other Regulators. *d.* 1.	*e.* 2.	*f.* 3.
2·5	·4	24			
1·5	·3	24			
·5	·4	24			Bad.
1·50 to 1·75	·3	19	Bad.	Bad.	Best.
1·75 to 2·00	·35	14	Good.	Good.	Blowing.
2·00 to 2·50	— ·4	9	Best.	Best.	
2·50 to 3·00	·4	4	Blowing.	Blowing.	
3·00 to 3·50	— ·45	1			

By order of the Committee,
Philadelphia, March 8th, 1855. WM. HAMILTON, *Actuary.*

BIBLIOGRAPHICAL NOTICE.

An Outline of Medical Chemistry, for the use of Students. By B. HOWARD RAND, A. M., M. D., Professor of Chemistry in the Philadelphia College of Medicine, &c., &c.

In this work, a want is supplied, which has heretofore existed, notwithstanding the great abundance of chemical manuals already published. The larger of these were often too comprehensive for the students' appreciation, and the various "Reviews," "Catechisms," &c., each contained too imperfect a condensation for his real improvement.

The preface to this "outline" explains its object as being to arrange such facts in medical chemistry as are of the *most importance*, in such a form as to be of easy reference for review; this outline requiring, of course, to be filled up by aid of more amplified text-books and lectures. The clearness and simplicity of the plan, the conciseness of its expression, and the completeness of the detail in all essential matters, adapt it to the especial needs of the class for whom it was designed, of medical students: while it has great advantages, also (for the same reasons,) as a work of reference, to the advanced chemical student, or practitioner, whose memory upon some points may have grown rusty.

We miss nothing that is desirable in such a work,—unless it be the extension, occasionally, of the explanation and illustration of chemical *principles*, which are sometimes obscure to the learner, however easy of application by the adept. A few minor typographical errors (such as the most lynx-eyed proof-reader may sometimes overlook) occur, which, we hope, the occasion for a second edition will soon enable the author to correct. The introduction of the enumeration of proximate animal principles from the treatise of Robin and Verdeil,—of the late researches of Heintz upon the fats,—of the medical uses of Quinidia,—of iodine, by Brainard, as an antidote for snake poison, &c., &c., show that Prof. Rand has spared no pains in bringing his work up to the present time, and in making it the most valuable "*multum in parvo*" upon chemical subjects that has issued from the press for a long time. Lindsay and Blakiston have published it in their neatest style.

JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

PROMOTION OF THE MECHANIC ARTS.

JUNE, 1855.

CIVIL ENGINEERING.

For the Journal of the Franklin Institute.

Disquisition on the Laws regulating the Slips of Screw Propellers in function of Form and Dimensions; based on a Digest of the Experiments made in 1845 *by M. Bourgeois, Engineer de Vaisseau, at the French Government Manufactory at Indret.* By B. F. Isherwood, Chf. Eng. U. S. Navy.

(Continued from page 304.)

Theoretical Perceptions.

There must be, of course, in the nature of things, sufficient causes for the effects summed up in the previous "*general conclusions;*" let us endeavor to ascertain these causes.

And first, with regard to slip itself. In order that any power may act, it is necessary, in general, that there be an object acted on and an object reacted on. In the case of screws employed for the propulsion of vessels, the vessel is the object acted on, and the water in which it moves is the object reacted on. Action and reaction, or more properly pressure and resistance, are equal and in opposite directions; therefore, whatever pressure is sustained by the vessel and which pressure produces its forward movement, the same is sustained by the water on which the screw acts, which water is the fulcrum of the power as the vessel is the load to be moved. Power is the product of pressure and motion, it is pressure in motion; motionless pressure is in no way power, but wherever there is pressure (or weight) in motion there is power. The same power can only be used once, and if following the exercise of a single power, different masses or weights are put in motion in different directions, they can only have that motion by virtue of a consumption of part of that power, the

aggregates equalling the total power exercised. If the watery fulcrum were perfectly resisting, that is, if it did not yield to the pressure of the screw, all the power applied to the screw (abstraction made of friction) would necessarily be expended in the propulsion of the vessel; but if, owing to the mobility of the water, it yield or recede a certain degree, then a mass of water has been set in motion, and an equivalent amount of the power applied to the screw has been expended in producing that motion. But we have seen that the pressure upon the vessel and upon the watery fulcrum is the same, and as power is the product of the pressure by the velocity, then the velocities of the advance of the vessel and of the recession of the watery fulcrum, measure respectively the powers expended on each. To this recession of the watery fulcrum the name of slip is given, which term expresses the difference between the speed of the screw in the direction of its axis and the speed of the vessel. The speed of the screw is obtained by multiplying its pitch by the number of revolutions made in a given time, the speed of the vessel through the water is obtained by observation; the remainder which is left after subtracting the latter from the former is the slip, and it is always expressed in per centums of the screw's speed. From the facts that the pressure exerted by the screw on the vessel and on the watery fulcrum is the same, and that the vessel and watery fulcrum move with certain velocities in consequence of that pressure, and that power is the product of pressure and speed; it follows, that of the total power developed, abstraction made of friction, portions are expended on the speed of the vessel and on the speed of the watery fulcrum in the ratio of those speeds; but by reason of slip, all the frictions themselves are increased in the ratio of the slip, because it is necessary for the machinery to function either that much longer time or with that much greater speed in equal times, to propel the vessel a given distance; therefore, the loss of useful labor caused by the slip is equal to the slip. That is to say, if the power exercised be 100 and the slip 20 per centums of the screw's speed, then a power of 20 has been uselessly expended. From this brief summary, it will be perceived how important it is for the economical use of power, that the slip be reduced to a minimum. From the foregoing it is also plain, that the slip measures exactly the difference between the resistance of the vessel and of the watery fulcrum; for the same pressure being applied to both, they will move in equal times distances inversely proportional to their resistances—with a slip of 20 per centum, the vessel has gone a distance of 80, while the fulcrum has receded a distance of 20, consequently the resistance of the watery fulcrum in this case is four times the resistance of the vessel.

If the water offered a perfectly resisting or unyielding fulcrum, the whole question would be very simple, the size of the screw would then be quite immaterial in function of any of its dimensions, and all screws, be their form or dimensions what they might, would be equally efficient propellers. But the mobility of water necessitates that a certain quantity of it be simultaneously acted on or pressed by the screw in order to obtain sufficient resistance to serve as a fulcrum to the power; hence, the screw must present an amount of propelling surface in proper relation to the resistance to be overcome, that is, to the vessel to be moved.

And as the slip measures the difference between the resistance of the vessel and the watery fulcrum, it follows, that doubling the screw surface, other things always equal, doubles the resistance of the watery fulcrum, and by consequence, halves its slip or recession. Let us apply this law to the case of otherwise equal screws, but having their diameters in the ratio of 1 and 2, the surface of such screws, being in the ratio of the squares of their diameters, will be as 1 and 4, consequently the screw of double diameter will experience from the watery fulcrum four times the resistance of the other screw, because it embraces or acts on four times the quantity of water, and as the fulcrum presents four times the resistance, its slip will consequently be one-fourth the slip of the other screw, that is to say, if the slip of the screw with the diameter 1, be 20 per centum, the slip of the screw with the diameter 2, will be 5 per centum. And this result, which makes the slip of otherwise equal screws to vary in the ratio of the square of the diameter, is precisely the effect we find to have been ascertained experimentally.

In the case of cutting out the inner portion of the screw blades by the passage of a cylinder whose axis coincides with the axis of the screw, it is plain from the foregoing, that if the resistance of the watery fulcrum, or the slip of the screw, be in proportion to the propelling surface of the screw, other things equal, then the slip with the cut-out screw should be increased in the direct ratio of the surface so cut out, provided the cutting out did not alter the equality of things—but, in the case of cutting out the screw, the comparison cannot be made directly in the ratio of the surface before and after the cutting out, because the part remaining after the cutting out is a ring at a distance from the axis, and the propelling efficiency of surface is, as we have seen, in the ratio of the square of the diameter, that is, in the ratio of the square of its distance from the centre; the slips should therefore be in the ratio of the square roots of the surface before and after the cutting out. Let us apply this deduction to the case of the cut-out screws of Series 2d, Table II, where the cutting out was effected by the passage of a cylinder of coincident axis with the screw and of a diameter equal to half the diameter of the screw. If, now, the diameter of the original screw be taken at 2, and its area represented by 4, the area of the cut-out part whose diameter will be proportionally 1, will be 1; consequently, the areas of the screw surface before and after the cutting out will compare as 4 and 3, the square roots of which are as 1·155 and 1·000, and in this ratio the slips should also be:—by referring to the experiments, it will be seen that the actual observed slips were as 1·143 to 1·000, a remarkably close approximation.

Again, with regard to the effect on the slip, by cutting out the inner portion of the blades of the screw by the passage of a cylinder of coincident axis, but of a diameter equal to three-fourths of the diameter of the screw, as with the screw of the 3d Series, Table II. In this case, if we take the diameter of the original screw at 4 and represent its area by 16, the diameter of the cut-out portion will be represented by 3 and its area by 9. The propelling surface of the screw, therefore, before and after the cutting out will compare as 16 to (16—9=) 7, the square roots of which compare as 1·512 to 1·000. By referring to the experiments, the actual slips will be found to compare as 1·408 to 1·000, a very close experimental approximation.

With regard to the effect exerted on the slip of the screw by the length of the pitch, other things being equal; we must consider that as the pitch measures the distance gone by the screw per revolution, it follows, that with a pitch of 1, the screw must make twice the number of revolutions to go a given distance that it would make with a pitch of 2. In both cases, however, the resistance—that is the vessel—would be moved equal distances, and present of course the same resistance. And as the propelling surface would be used with the pitch of 1 twice, where it would be used only once with the pitch of 2, while the resistance or vessel was carried through the same space, it would experience from the watery fulcrum twice the resistance and have one half the slip. In fact, the effect of reducing the pitch of the same screw from 2 to 1, is precisely the same as if two equal screws with pitches of 2 were used, that is, we double by it the resisting surface, and consequently halve the slip. By referring to the numerous experiments, it will be perceived that this result, which makes the slip of otherwise equal screws to be in the direct ratio of their pitches, is there very closely approximated, and the deductions of theory will be found in complete accord with the observations of practice.

With regard to the influence exerted upon the slip by employing less than one convolution of the thread, or by fractioning the pitch; it is plain, that were there no slip at all, every portion of the screw surface would be equally efficient propulsively; but the immediate effect of slip is to set the water pressed by the screw in retreating motion with a certain speed; now from the mode of action of the screw, every portion of the blade from the anterior to the posterior edge presses successively the same molecules of water, and these molecules being set in motion by the portion of the blade at the anterior edge, the succeeding longitudinal portions of the blade receive from the retreating molecules a less resistance, and less by the difference of the squares of the speeds of the blade and of the water. If we imagine that a very narrow strip radially at the anterior edge of the blade first sets a correspondingly small mass of water in motion, it is plain that small mass will rapidly lose its velocity from the smallness of its momentum—the effect of the smallness of its mass—and the succeeding very narrow strip will press it with but little less resistance than the first. We will now imagine these first two very narrow strips to press the water and set it in motion by that pressure, the water thus set in motion being twice the mass of what it was on the first supposition, will have twice the momentum and retain its speed correspondingly longer in virtue of that greater momentum; so that the next succeeding narrow strip of blade will, of course, obtain from it a less resistance than was received by the immediately preceding strip from its predecessor, and so on until the posterior edge of the blade is reached: the mass of water set in motion by the strips of the blade becoming greater and greater as strip after strip is brought into action, and by reason of its increasing mass having greater and greater momentum, it retains by virtue of that increasing momentum the speed imparted to it longer and longer, so that each succeeding narrow strip of blade meets with a continually decreasing resistance from the water on account of its continually increasing speed in the same direction that the blade is moving; so that

when a certain length of blade is employed, it will be found that the rear strips receive scarcely any resistance from the retreating water, which has obtained nearly the velocity of the screw itself. From these considerations it is evident, that the velocity of the water set in motion by the screw increases with accelerated speed from the front to the rear of the blade; the ratio of this acceleration can only be deduced from the different resistances observed with different lengths of blade; it will, of course, be in the same ratio that the experimental slips decrease for increased length of blade.

From these considerations there also follow, that as each doubling of the same screw surface endows the water set in motion by it with twice the momentum, because twice the mass is put in motion with the same velocity;—that the *ratio* of decrease of the slip due to each doubling of the surface, be the absolute amount of surface what it may—will be constant, be the absolute slips what they may; for the *ratio* between the momentums 1 and 2 will evidently always be the same, let their *absolute values* be what they may: and this deduction we find to have been fully confirmed by the experimental results, the ratio of increase of slip by a doubling of the surface being 1·151.

We have thus far considered only the effect of fractioning the pitch by decreasing the length of the blade; but with poly-bladed screws this fractioning can also be effected by the omission of blade after blade; and here we find what could only be discovered by experiment, that the same effect is produced on the slip of the screw by the deduction of equal amounts of surface, whether made in the length of the screw by the passage of a plane perpendicular to the axis preserving the same number of blades, or by the omission of blades preserving the same length of screw. This can only be accounted for on the supposition, that as the blades revolve in the same vertical plane while they advance in a direction at right angles to that plane, their actions interfere, and instead of allowing each to receive from the water the full resistance it would experience were there but one blade in use, it only allows the aggregate resistance obtained by all the blades to equal what it would be with the same surface arranged lengthwise in a fewer number of blades or in a single blade. I cannot, however, trace the reasons that connect by the same ratio of decrease, the slips of the screw by equal reductions of surface, whether made in its length or in the number of its blades. It rests purely on the experimental determination.

The arrangement of the blades of the screw checkerwise, can evidently exert no influence on the slip, in view of the facts contained in the immediately preceding paragraph, because such a disposition of the blades amount to merely a suppression of half their number and a doubling of the length of the screw—preserving throughout the same surface. The result of the direct experiment, was an exact confirmation of the other experiments, showing that the arrangement of the same surface in one or many blades was attended by precisely the same slip.

With regard to the effect exerted on the slip by the curved directrix or expanding pitch, it is necessary to first premise, that by an expanding pitch is understood a pitch which momentarily becomes greater and greater as we pass from the anterior to the posterior edge of the blade. From

this definition there follows, that a screw with an expanding pitch may be considered as composed of an infinite number of screws contiguously arranged on the same axis, and the same in all respects except the pitch, which increases continuously for each fractional screw as we pass from the front to the back end of the axis. We have seen that the slips of otherwise equal screws are in the direct ratio of their pitches, therefore the slip of each of our fractional screws will be in the ratio of their pitches. As each of these fractional screws, proceeding from front to back, have constantly increasing pitches, and as they make revolution for revolution, it is obvious, that they press the water with constantly increasing longitudinal speeds, so that the same water which has been pressed by the initial small pitch and endowed with a slip or velocity of recession proportionable to that pitch, is still vigorously pressed by the succeeding larger pitch with its greater longitudinal speed and slip, and so on to the end of the blade; whereas with the straight directrix the longitudinal speed of the entire screw is uniform, and following portions cannot, as it were, fully *catch up* with and press the water already set in motion by the preceding portions, with any approach to the pressure that the preceding portions exerted on it. The increased efficiency, then, of the curved over the straight directrix, results from the fact, that the longitudinal speed of the screw with the curved directrix continuously increases as we pass from the front to the back, so that the water set in motion by the preceding portions receive from the following portions a greater pressure than they could receive with an otherwise equal screw of straight directrix, whose longitudinal speed for its whole length is uniform. With a screw whose directrix had the curvature of those experimented on, the increased resistance over what would have been obtained with a straight directrix of a pitch equal to the mean pitch of the curved directrix, amounts to six per centum: that is to say, a slip of 30 per centum with the straight directrix would be reduced to 25 per centum with a curved directrix.

An oblique and also a curved generatrix, which is the same as an oblique generatrix whose obliquity is constantly varying, had its origin in the idea that the screw in its rotations endowed with a centrifugal force the water comprised between the blades—that in consequence of being endowed with this centrifugal force this water moved with a certain velocity radially from the axis outward, and that by inclining or curving over the blades, this water could be made to impinge upon them, and thus a certain amount of its power be made to assist in turning the screw and consequently in propelling the vessel. There is nothing, however, in the nature of things to countenance this idea, which is essentially fallacious throughout. The effect of the rotation of the screw, is not at all to give the water comprised between its blades a rotary speed, but to pass that water through with a longitudinal speed in the direction of the axis; a rotary speed and centrifugal force could only be imparted to this water by closing up the front and back of the screw and confining the water between the blades, for as long as the water is not so confined, it will, in consequence of the very rotation of the screw, pass through it longitudinally and be endowed with no centrifugal force whatever; and this effect will be the same, whether the screw be held stationary longitudinally and rotated in the water, or whether it move freely longitudinally

in virtue of that rotation. The experiment with an oblique generatrix fully confirms this deduction, and shows that the effect of such a generatrix on the slip is nothing. A very satisfactory experiment in point was made in England, in 1841, by the Russian General Sabloukoff, on a small screw of 2 feet diameter, composed of one convolution of the thread arranged in two blades. This screw was held stationary, longitudinally, and rotated in the air at a high velocity, and smoke was used to render the phenomena visible, which was, of course, the same as though water had been the medium rotated in. Galloway, an eyewitness, relates the results as follows, viz: 1. The smoke being let on at the anterior or front side of the screw at any point near the periphery, *was drawn towards the screw and carried to the after end.* 2. The smoke being let on at the anterior side of the screw near the hub, *ran along the hub parallel thereto*, and did not appear to acquire *any circular motion.* 3. The smoke being let on at or near the periphery of the screw at its posterior side, was thrown *from* the screw. I have, myself, repeated these experiments on a small screw of about 2 feet diameter, composed of about two-thirds of one convolution of the thread and arranged in six blades. The results were precisely the same; the throwing *from* the screw when the smoke was let on at the posterior side of the screw near the periphery, was in a direction at right angles to the surface of the blades, and not in a radial direction from the axis. At no part was there any indication of a rotary motion having been acquired, and not a vestige of any centrifugal force.

With regard to the influence exerted on the slip by surrounding the blades of the screw with a drum fastened to and moving with them, it is plain, that such an arrangement was based on the same idea of centrifugal force, and that the water displaced by that force in a radial direction from the axis left a vacuum about the centre of the screw. It was, therefore, imagined, that by forcibly holding back this radiating water, it would be kept solid about the axis and give its additional resistance to the central portions of the screw. The direct experiments showed that the band or drum exerted no influence on the slip, which was precisely what might have been expected, for it was only an attempt to obviate an evil which did not exist.

The cause of the trepidations of the screw, or knockings at the stern of the boat, can easily be traced. It results entirely from the want of equilibrium in the pressure on the opposite sides of the shaft exercised by the opposed blades of the screw. There must first be premised, that the resistance of water is in the direct ratio of its depth; a square foot of surface moving in water at a depth of 10 feet will receive twice the resistance it would experience in moving with the same velocity at a depth of 5 feet. Let us take the case of a two bladed screw; these blades in their rotation pass from the upper vertical to the lower vertical position relatively to the axis, and if we suppose the periphery of the blade to just touch the surface of the water when in the upper vertical position, the blade will then have only half the pressure or resistance on it that it will have when in its lower vertical position, and so on relatively when in all other positions except the horizontal, which is the only one where the pressure will be exactly balanced; in all other positions the shaft will be forced towards one side by the unequal pressure of the blades, producing trepidations, the resultant of pressure passing around in the direc-

tion of rotation. If the shaft have some play in the stern bearing, violent knockings will be produced, and in all cases the vessel will have at the stern, whether accompanied or not by trepidations, the strong vibratory or wriggling movement, peculiar to and always observable on screw vessels of even the largest size and strongest build. The slower the vessel goes, the more strongly marked will the trepidations be, because the mass of the machinery will have then less momentum to distribute the inequality among. It is obvious that an increase in the number of blades will more nearly balance the pressure around the axis, and it is found that practically, three blades give but slight trepidations, which wholly disappear with four blades. With one blade, on the contrary, the trepidations are very strong, as might be expected from the totally unbalanced pressure. With two blades there will always be marked trepidations, injurious both to the machinery and vessel. From the same inequality of the resistance of water at different depths, it occurs, that when in a vessel propelled by a screw the machinery is suddenly stopped and the screw in a fixed position is dragged through the water, it will be observed that the vessel will at once deflect from the direction it was pursuing (unless corrected by the helm) in consequence of the unequal resistance offered on the opposite sides of the stern post by the blades of the screw, except in the rare case when the blades happen to be stopped equally arranged on both sides the perpendicular. The wriggling or vibratory movement at the stern of screw vessels is precisely the same and has the same cause, as the movement observed at the stern of a boat sculled by a single oar.

With regard to the effect exerted on the slip of the same screw by its greater or less rotary speed, it is plain, that with the same screw double the rotary velocity will *always* give four times the pressure; for the surface and mode of action of the same screw evidently cannot change by mere change of rotary speed, and double the rotary speed will, of course, give double the longitudinal speed. Now, if the resistance of the vessel increase in the ratio of the square of its velocity, which is sensibly the case with most vessels at speeds within the limits of ordinary practice; then, the resistance of the vessel and of the watery fulcrum pressed by the screw, increase in the same ratio; consequently, the slip of the same screw must remain unchanged, be its rotary velocity and corresponding speed of vessel what they may. If the resistance of the vessel increase in a higher ratio than the square of its speed, then the slip of the same screw will increase proportionally to that higher ratio, and *vice versa*.

ERRATA.

Page	158,	line	18th	from	top:	for	"*the slips; again*"	read "*the slip again;*"
"	161,	"	1st	"	"	"	"*fraction of the form*"	" "*function of the form.*"
"	"	"	11th	"	bottom	"	"*directly*"	" "*directed.*"
"	"	"	2d	"	"	"	"*decreased additional*"	" *decreased the additional.*"
"	222,	"	9th	"	"	"	"*determining*"	" "*determined.*"
"	225,	"	16th	"	top	"	"*of convolution*"	" "*of one convolution.*"
"	225,	"	5th	"	bottom	"	"*comprising*"	" "*composing.*"

" 227, In the titles of both tables for "*screw*" read "*screws.*"

" 297, In the heading of the first column of the table, for "*Diameter of the screw*" read "*Designation of the screw.*"

For the Journal of the Franklin Institute.

On the Circumference of the Ellipse. By T. W. Bakewell.

The "Books" contain several Rules for finding the circumference of the ellipse, varying somewhat in detail, but all formed on similar and erroneous premises, and are consequently incorrect in their results.

Two of the given forms are:

Rule A. "$\overline{(\sqrt{}_4 D^2 + d^2) \times 1{\cdot}11}$" for circumference of $\frac{1}{4}$th the ellipse.

Rule B. "Circumference $\frac{199}{200} p \sqrt{\tfrac{1}{2}(D^2 + d^2)}$" for diameter of a circle, equal to that of the ellipse sought.

No rule is accurate that will not bear the test of the two extremes of the ellipse, viz: a circle and a straight line. Rule A, is short in the circle, is nearly correct with axes $\frac{6}{7}$, and is thence in an increasing excess with the eccentricity.

With a line, or ellipse of $\frac{0}{1}$, the correct circumference (perimeter) is 2 —but the rule A gives 2·22, and rule B, 2·2214.

The multiplier 1·11 of rule A, is probably intentionally curtailed from 1·11072, the quotient of $\frac{1}{4}$th of a circle divided by its chord, radius being 1, the latter multiplier giving the *circle* correctly.

Rule B, falls short in the circle, by that part of the formula, "circumference$=\frac{199}{200}p$;" which means $\frac{1}{2}$ per cent. off, uniformly; its nearest approach to truth, is with diameters $\frac{4}{5}$, but is in excess beyond those proportions, in about the same ratio as rule A.

The following rule is exact, the letters referring to the example. Diameters of ellipse d* $\frac{2}{8}$, considered as a vulgar fraction, reduced to a decimal$=$·25b make complement for unity$=$·75c, from which subtract as the axes, viz: $\frac{2}{8}=$·1875s; the remainder is r ·5625. Multiply the decimal ·13662t by the difference of the axes$=$6, the product is ·81972v, which product, multiply by the above remainder r·5625$=$·4610925h, to which add mean of axes$=$5, and the sum 5·4610925f is the diameter of a circle of which the circumference is also that of the ellipse.—

$$
\begin{array}{llll}
 & d\ \tfrac{2}{8} = \cdot 25\,b & & \\
 & \overline{\cdot 75\,c} & \cdot 13662\,t & \\
\text{subtract } \tfrac{2}{8} = & \cdot 1875\,s & \quad 6 & \\
 & r\cdot\overline{5625} \times & \overline{\cdot 81972\,v} = & \cdot 4610925\,h \\
 & \text{add mean of axes} = & & 5. \\
 & \text{correct,} & & \overline{5\cdot 4610925\,f} \\
 & \text{By Rule A,} & & 5\cdot 751177 \\
 & \text{By Rule B,} & & 5\cdot 801798
\end{array}
$$

The constant (in all cases) multiplying decimal † ·13662t of the differences of the axes, is the excess of the required diameter over the mean of the axes in the ellipse (or line)$=\frac{0}{1}$ mean ·5 required excess for circumference or perimeter of 2. $\frac{\cdot 13662}{\cdot 63662}$.

* This (d) and the following, are letters of reference only.—Com. Pub.

†More accurately ·1366197697+

The subjoined Rule on the same principle as the above, may be more easily understood.

The example will explain itself:—

Ellipse $\frac{2}{8}$ diff. $6\times$	·13662
	·81972
Subtract as axes $\frac{2}{8}=$	·20493
	·61479
Subtract again from remainder $\frac{2}{8}=$	·1536975
	·4610925
Add mean of axes	5·
Diameter for cirumference of circle and ellipse,	5·4610925

Cincinnati, April, 1855.

AMERICAN PATENTS.

List of American Patents which issued from April 10, *to April* 24, 1855, (*inclusive,*) *with Exemplifications.*

APRIL 10.

49. For an *Improved Lathe;* Warren Aldrich, Lowell, Massachusetts.

Claim.—"I herein claim a combination, (when used in connexion with a tool rest or carriage, a rotary carriage, and a sliding carriage, disclaimed,) consisting of a long screw, *b*, a vertical shaft, two worm geers, and a screw, *n*, arranged, applied, and made to operate together."

50. For an *Improvement in Drills for Artesian Wells;* J. Andrews, Winchester, Mass.

Claim.—"The use of a stiff chain, for the purpose of operating a rock drill, or other artesian borer. Also, the device for rotating the drill, consisting essentially of the cog wheel and pinion, with the parts which set them in motion."

51. For *Saw Teeth;* Nelson Barlow, Newark, New Jersey.

Claim.—"The improvements, consisting of the recessed space and combined cutters upon the sides of saw teeth, and also the rounded form given to the outer points of the teeth."

52. For an *Improvement in Steam Boilers;* Horace Boardman, Plattsburg, N. H.

Claim.—"1st, The graduating of the openings in the flues or tubes. Also, in connexion with the flues or tubes, the semi-division flue plates in the chamber, for regulating and equalizing the egress of the heated products through said tubes. Also, the inclination of the tubes and tube sheets, for the double purpose of preserving a space between the tube for the sediment to collect in, and from which it can be readily removed, and for preserving a square surface between the tops of the tubes and said sheets, so that they can be fairly riveted."

53. For an *Improved Machine for Raising and Transporting Stone;* Solomon E. Bolles, Rochester, Massachusetts.

Claim.—"The construction of an axletree for a 'stone digger,' in combination with the bed frame and derrick."

54. For an *Improvement in Rotary Harrows;* L. Brainard and L. Newton, Ithaca, N. Y.

Claim.—"The employment of the wheel-shaped harrow, when fastened upon a central point, so as to turn in either direction."

55. For an *Improvement in Machinery for Winding up Lines, Twist, or Cord;* Byron Boardman and George C. Sweett, Norwich, Connecticut.

Claim.—"1st, The sweep, composed of an arm attached to a hollow shaft, and carrying a hollow tube, which is caused, by the revolution of the shaft, to lay round the fixed hooks a line, cord, twist, or other fabric of similar character, which is conducted through the shaft and the said tube. 2d, So arranging, applying, and operating the sweep and the hooks around which it lays the line or other fabric, that the hooks shall remain stationary in a suitable position to receive the line or fabric while the sweep revolves around them, and that the hooks, after the operation of the sweep terminates, shall rotate upon axes in line with each other, to perform the woolding. 3d, Giving the tube of the sweep a motion endwise, simultaneously with its revolution, by any means, for the purpose of laying the line or fabric evenly on the hooks, and preventing its being laid in heaps. 4th, The manner of disengaging the pulley, or its equivalent, which drives the sweep shaft, in order to stop the sweep at the proper time, and in the proper position, by means of the sliding piece, the lever, and the adjustable pin in the ratchet wheel, or its equivalent, deriving motion from the sweep shaft. 5th, The rod, arranged and operating for either or both of the purposes herein set forth, viz: 1st, To carry a clasp which regulates the woolding; and 2d, To carry fins, pins, or other projections, to operate a catch, or its equivalent, to cause the engagement and disengagement of the gearing which gives revolution to the hooks to perform the woolding. 6th, The application to the clasp of a catch lever, to hold the jaws open during the laying operation, and to be caused to liberate them by the falling of the clasp, to allow them to close ready for the woolding operation."

56. For an *Improved Arrangement of Dies and Stocks for Ornamenting Metal Tubes;* Stephen M. Cate and Edmund Jordan, Waterbury, Connecticut.

Claim.—"The combination of the adjustable die stocks with the revolving dies, in a self-feeding machine for ornamenting tubes, &c."

57. For an *Improvement in Boot Forms;* John Chilcot and R. Snell, Brooklyn, N. Y.

Claim.—"1st, The inner clamp fitted to a recess in the front piece, so that its exterior presents the desired surface for a part of the front piece, whereby, after having held the first edge of the front seam of the leg seam to the front piece, till the whole piece of material is lapped to the proper form, it may be drawn out lengthwise and re-inserted in the front piece, inside the edge it previously held, and thus throw out the said edge and part of the material immediately behind it, into contact with that part of the material which overlaps, and is to be united to it to make the seam. 2d, The exterior clamps attached to screws, working in an upright, which is attached to the front piece in a suitable position for the clamps to hold the two parts of the front seam together, and to allow the said front piece to be taken from the upper."

58. For an *Improvement in Recording Votes in Legislative Bodies;* Thomas C. Connolly, Washington, District of Columbia.

Claim.—"The moving of the slides containing the members' names, into columns of yeas and nays; this arrangement being one that is well calculated for the convenient display of the vote to all the members of the body voting. Also, the arranging of a series of types, stereotype, or plates, in a galley, by a system of levers, cords, wires, &c., extending from each desk or seat to said galley, so that any number of impressions of the exact record of the vote taken, may be instantly printed or struck off. Also, the so arranging in a galley of a series of types, stereotype, or plates, as that they may be readily moved therein to the left or right, and instantly locked into form, from which printed impressions may be taken by any of the well known means."

59. For an *Improvement in Seed Planters;* Jason W. Corey, Crawfordsville, Indiana.

Claim.—"The adjustable seed or slide box. Also, the arrangement of adjustable slide, adjustable seed gauge, coiled spring, and connecting rod, together with grooved roller, slotted arms, front share, adjustable clod mover, and covering shares."

60. For an *Improvement in Locomotive Boilers;* Josiah J. Dutcher, New Haven, Conn.

Claim.—"1st, The arrangement of water spaces within and contiguous to the furnace, and leading therefrom to the body of the boiler, consisting of the horizontal pipe, inverted cone, upright tube, and horizontal tube. 2d, In combination with a hinged fire grate

or grates, to the boiler furnace, I claim providing hinged traps in the ash pan, to be lowered and raised or opened and closed simultaneously with the fire grate or grates, by means of an upright rod passing through the boiler, and suspended from a lever within the control of the engineer or fireman, while at his usual post, the said rod operating upon the said grates and traps, by means of arms, or their equivalents. 3d, Retarding the escape, down the inclined ash pan, of the ashes, coal, &c., falling thereon through the grate, by means of curb plates, arranged to make the said ashes, coal, &c., take a circuitous direction."

61. For a *Card Exhibitor;* Wright Duryea, City of New York.

Claim.—"The improvement in card exhibitors and distributors, consisting in the application of the roller, printed strip, guide, and self-closing spring holder."

62. For an *Improvement in Portable Door Fasteners;* Benjamin R. Eames, South Newry, Maine.

Claim.—"The combination of bifurcated hooked bar, spring, compensator, and horizontally moving brace; the compensator and brace movable about the vertical connexion of said bar, whereby the self-movement of the brace is prevented, while it performs the double function of gauge and brace."

63. For an *Improvement in Framing for Building Concrete Walls;* Salathiel Ellis, City of New York.

Claim.—"The construction of the clamps, so that they can be moved or turned up, as necessity requires, and the combination of these clamps with the rods and boards to form a self-supporting frame."

64. For a *Tool for Boring Hubs;* Henry C. Garvin and J. H. King, Hagerstown, Md.

Claim.—"The apparatus for boring wagon and carriage hubs for reception of boxes, (narrow and through boxes,) using for that purpose the aforesaid apparatus, or any other substantially the same."

65. For an *Improvement in Furnaces for Burning Wet Fuel;* Moses Thompson, Henrico County, Virginia.

Claim.—"The combination, for the purposes of a high degree of heat, of bogasse, refuse tan, saw dust, and other refuse substances, or very wet and green wood, by the employment of a series of fire chambers, arranged in any manner, to communicate with one flue, when any number of the said chambers are nearly closed to the flue, and to the admission of air, when first charged, while the remaining chamber or chambers are in free communication with the flue, and has a free supply of air admitted, and each chamber in its turn is nearly closed and then opened, and has air admitted, whereby the heat required is furnished by the combustion of the fuel in one or more chambers, while the fuel in the other chamber or chambers is being heated and decomposed to a desirable degree, no artificial blast being used."

66. For a *Mode of Guiding Reciprocating Saws;* C. B. Hutchinson, Auburn, N. Y.

Claim.—"In the mode of hanging saws for saw mills, the use of a thin guide plate for holding and guiding the saw placed immediately behind and in the same plane with it, and following it through the log, whether the same be used by itself, or in connexion with any other means of holding and guiding the saw."

67. For an *Improvement in Railroad Car Coupling;* James H. Jones, Scio, N. Y.

Claim.—"A car coupling without a link, which may be a permanent fixture on the car, and each half so formed as that the jaws or hooks will always couple or catch, the one with the other, when brought together, regardless of the particular ends of the cars which may be brought together."

68. For an *Improvement in Fire Arms;* Ferdinand Klein, Newark, New Jersey.

Claim.—"An improvement in the manner of opening and closing the valve or cover of the chamber which receives the charge. Also, the use of a cap, for the purpose of protecting the chamber and the spring that moves it."

69. For an *Improvement in Steam Generators;* Alex. B. Latta, Cincinnati, Ohio.

Claim.—"1st, Combining a steam generator or boiler, consisting of a coil of tube with a furnace, in such a manner that the flame or products of combustion shall come

in immediate contact with said coil, when this coil is combined with a feed apparatus and gauges, which will enable the engineer to inspect constantly the supply of water, see that it is not interrupted, test its sufficiency, and regulate it at pleasure, according to the varying demands of the boiler, or close the dampers if the feed should be interrupted. Also, while confining the admission of water to the receiving end of a coiled tube boiler, limiting the quantity therein, and the supply thereof, to the quantity demanded for immediate conversion into steam, for the purpose of avoiding the weight of a large quantity of water, for producing steam promptly, saving fuel, and preventing the water from being thrown out of the tube by the steam formed in the lower part thereof. Also, causing the discharging end of a coiled tube generator to communicate with and discharge itself into the water jacket, while all other communication of said coil with said water jacket is avoided."

70. For an *Improvement in Straw Cutters;* Walter Lackey, Worcester, Mass.

Claim.—"The use of the heads, when made to correspond with the flanch or flanches, to facilitate the setting of them, and prevent their striking over the stationary knife or bed. Also, the flanches, in combination with the heads working against the stationary knife. Also, the combination of the flanches, heads, stationary knife, and feed rolls, or any other substantially the same."

71. For a *Spiral Wheel for Replacing Railroad Cars upon the Track;* Robert F. R. Lewis, Annapolis, Maryland.

Claim.—"The application of one or more cast or wrought iron hollow cylinders, wormed, flanched, or screw threaded on their exterior surfaces, in the manner of a plain screw to rail trucks or carriages, in place of, or in combination with the common or ordinary flanch wheel, and thereby prevent the same from running off, or being thrown from the track whilst in forward motion."

72. For an *Improvement in Graduating the Tension of Car Brakes;* W. Loughridge, Weverton, Maryland.

Claim.—"The combination and arrangement of the sliding plate, having a series of holes graduated for limiting its play by an adjustable pin, the supplementary chain, wound upon the chain barrel, which receives the chain for actuating the brakes, the lever for bringing the said barrel into and out of action, the spring catch for holding the said lever in engagement until tripped by the pin of the aforesaid sliding plate, when the lever is released and the power is maintained without any further increase; the whole constituting an automatic disengaging apparatus, capable of being graduated so as to apply and retain any degree of frictional pressure that may be previously desired, by the simple adjustment of the movable pin in the sliding plate."

73. For a *Stationary Hydro-Pneumatic Engine for Extinguishing Fires;* William Loughridge, Weverton, Maryland.

Claim.—"1st, The employment, for the purpose of supplying water for fires and ordinary uses at the same time, of the supply and force pipes connected, by connecting pipes fitted with valves, said supply pipe being connected with the suction, and said force pipe with the discharge of a force pump. 2d, The application of the weight, or its equivalent, to the driving shaft of the pump, in connexion with a brake, for the purpose of setting the said shaft in motion by the mere act of liberating it from the restraint of the brake, and thereby calling the attention of the engineer, and continuing to drive it until the engineer can get the engine ready and connect it, thereby obviating the necessity of having the engine always connected and in readiness. 3d, The combination of the signal pipe, the tank and float, the signal pipe being connected either with the supply or force pipe, and the float with the brake lever, for the purpose of enabling a person at any distance from the forcing pump to set free the brake and start the pump instantaneously, and to give notice to the engineer when to connect the engine, or get it in readiness."

74. For an *Improved Machinery for Boring Wells;* John F. Manahan, Lowell, Mass.

Claim.—"The boring cylinder, having a cutter at its lower end, and an adjustable cutter in its periphery for enlarging the hole so that the auger cannot bind when in use, and so that the tube designed to line the well can follow the auger or cylinder downwards, and allow this auger to be drawn up through the lining tube, by the shutting or moving of the enlarging cutter. Also, the metallic chain of buckets, in combination

with the earth cutter, operating or moving in such manner within it as to receive the earth as fast as it is cut from the ground, and elevate it to the desired height."

75. For an *Improvement in Machines for Paring Apples;* Samuel N. Maxam, Shelburne Falls, Massachusetts.

Claim.—"The inclined plane scroll, combined with the movers, or their mechanical equivalents."

76. For an *Improvement in Cultivators;* A. H. Morrel, Marlen, Texas.

Claim.—"1st, The combination of the adjustable thinning point or points, at the forward end of the cultivator, with the adjustable cultivating point or points at the rear end of the cultivator. Also, combining the rotating cutter with the laterally adjustable thinning point or points, and the cultivating point or points."

77. For a *Machine for Mortising Blinds;* Benjamin J. Norris, Lynn, Mass.

Claim.—"The manner of constructing and operating the hollow pulley and spindle, together with the levers attached. Also, the manner of operating and guiding the stock, by the combination of the lever with the racks and the movable detents."

78. For an *Improved Gas Regulator;* Samuel P. Parham, Trenton, New Jersey.

Claim.—"A conical valve, or its equivalent, operated by a jet of air, gas, or water applied immediately under it, or against a cup or valve connected to it, in combination with an elliptical seat, or its equivalent, so constructed as to let the requisite supply of air, gas, or water escape when the valve is forced into the seat, the whole being so constructed and arranged as to regulate and equalize the flow of air, gas, or water, and furnish a uniform or nearly uniform supply under different degrees of pressure."

79. For an *Improvement in Bedstead Fastenings;* Joseph Rodefer, Cincinnati, Ohio.

Claim.—"The circular split ring let into a segmental annular mortise in the rail, from which its upper end projects in the form of a hook, and its lower end in form as described, permitting the passage of the catch pin in the act of insertion, affording an additional lateral bearing and a means of adjustment."

80. For an *Improvement in Straw Cutters;* Ira Rose, Akron, Ohio.

Claim.—"The combination of the cam, yoke, and lever, with the rock shaft and pawls."

81. For *Improved Venetian Window Blinds;* Charles Rose, Allentown, Pennsylvania.

Claim.—"In combination with the lower head and blind, the additional or upper head, and the hooks and cords, for readily connecting or disconnecting the two heads, for the purpose of placing or removing the blind from the window."

82. For an *Improvement in Straw Cutters;* David Russell, Drewersburgh, Indiana.

Claim.—"1st, The knives, in combination with the double crank and lever, thereby giving to the knives an oscillating reciprocating motion, by which means I obtain two shear cuts of the knives at each revolution of the double crank. 2d, The cam lever and crank, in combination with the levers and pawls, ratchet and feed rollers, for the purpose of feeding the straw or other material to the knives."

83. For an *Improvement in Straw Cutters;* Samuel J. Sharp, Danville, Missouri.

Claim.—"The arranging a circular knife and a circular guard upon a common pivot, so that they will revolve one towards the other until they meet, each traveling the same distance, or the arranging two knives, circular, upon a common pivot, so that they will revolve towards each other until they meet."

84. For an *Improvement in Platform Balances;* David M. Smyth, City of New York.

Claim.—"The arrangement of the platform, with hangers suspended at four corners to the two rockers, which are linked together, when this is combined with the weighted arms on the rockers, operating on the principle of the bent lever."

85. For an *Improvement in Straw Cutters;* Thos. C. Simonton and Loren J. Wicks, Paterson, New Jersey.

Claim.—"The combination of the cylinder with the knives attached to its periphery, and vibrating bed."

86. For a *Plate Holder for Cameras;* Albert S. Southworth, Boston, Mass.

Claim.—"The plate holder, in combination with the frame in which it moves."

87. For an *Improvement in Adjustable Friction Rollers;* John and Thomas Sweeney, Birmingham, Pennsylvania.

Claim.—"The use of sliding boxes to carry the journals of the friction rollers, in combination with the springs, for the purpose of pressing them all continually against the surface of the journal or gudgeon of the shaft, which works in the rollers so as to make them all revolve as the journal revolves, not only on their own axes, but around the journal."

88. For an *Apparatus for Feeding Paper to Printing Presses;* J. B. Hall, City of N. Y.

Claim.—"1st, Lifting or picking up the sheets of paper from the feed boards or piles of paper to be printed, by means of nippers, pincers, or tweezers, operated by any suitable mechanism, so that the jaws of said nippers may, when slightly open, press upon the sheets of paper in such a manner that when closing, they may grasp or nip the upper surface of the top sheet, or the ridge of the sheet formed between them by their pressure. 2d, Separating or detaching the uppermost sheet of paper on the feed board or pile of paper to be printed, so as to prevent the removal therefrom of more than a single sheet at a time, by means of the hooks, or by pins or points, so constructed and operated as to answer the same purpose, and rollers attached to a shaft or other suitable fixtures, and in connexion with said hooks and rollers, by means of a reciprocating motion of the platform, feed board, and pile of paper; the said hooks, pins, or points acting conjointly with the said movable platform. 3d, Conveying the raised sheets of paper from the feed boards to the form to be printed, and also from the form when printed, to the proper boxes or receptacles, by means of the fingers attached to the tube and shaft, which is secured to endless bands or cords, which are pinned with collars or teeth to prevent them slipping in passing around suitable pulleys, or by means of other fixtures which would be equivalent to the above named parts, when they are used in connexion with a vibrating or movable frame, or its equivalent, for properly adjusting the printed sheets in the boxes or receptacles when released from the fingers."

89. For an *Improvement in Cabin Chairs;* William Thomas, Hingham, Mass.

Claim.—"Placing the seat within a frame which is attached by pivots to the body of the chair, the seat having friction rollers or wheels attached to its under side, which work upon the lower curved portion of the frame, whereby the frame and body of the chair are allowed to turn or be inclined in accordance with the motions of the vessel, and the seat at the same time always remaining in a horizontal position."

90. For an *Improvement in Wooden Splice-Piece for Railways;* Isaac R. Trimble, Baltimore, Maryland; dated April 10th, 1855; ante-dated October 10th, 1854.

Claim.—"The combination of a wooden splice-piece strong enough to resist the lateral and vertical disturbances to which the adjacent ends of rails are liable, in combination with any form of rail competent to its purpose, without other support throughout than its own stiffness, the said splice-piece and rail in the combination now claimed, being fastened together and fastened down."

91. For a *Device for Allowing Circular Saw Spindles to Yield;* Hiram Wells, Florence, Massachusetts.

Claim.—"Arranging within the box or bearing, and combining with it and the saw spindle, the guide, its spring, and the compound frustra conical grooves provided with shoulders, the whole constituting a device of great simplicity of construction, and of much advantage in not only allowing a circular saw, while in operation, to move laterally, but to limit such movement of it, and subsequently restore it to its normal or original position."

92. For an *Improved Implement for Boring the Earth;* C. N. White, Concord, N. C.

Claim.—"The combination of the frame and weight, with the movable inclined rods attached."

93. For an *Improved Paint Mill;* David E. Paynter, Assignor to Israel M. Bissell, Philadelphia, Pennsylvania.

Claim.—"The arrangement and combination of the double cone with the barrel."

94. For an *Improvement in Lathes for Turning Locomotive Drivers;* J. M. Stone, Manchester, New Hampshire, Assignor to Manchester Locomotive Works.

Claim.—"The drills, in combination with the turning lathe, the one being mortised through the face plate, the other through the foot stock."

APRIL 17.

95. For an *Improvement in Bleaching Apparatus;* C. F. Appleton, Roxbury, Mass.

Claim.—"The combination of an air-tight vat for receiving and retaining the goods, an apparatus for exhausting the air therefrom, and the necessary vessel containing the liquids used in the process of bleaching, whereby the various steps may be performed in a much shorter space of time than has heretofore been required, and without removing the goods from the vat."

96. For an *Improvement in Sash Fasteners;* Wm. E. Arnold, Rochester, New York.

Claim.—"The mode of constructing and arranging a slide bolt and case so as at pleasure to form either a right or left hand lock."

97. For an *Improvement in the Construction of Gas Retorts;* H. P. M. Birkinbine, Philadelphia, Pennsylvania.

Claim.—"The gas retort with the annular space above, cast with and making a part of it."

98. For an *Improvement in Machines for Punching Metal;* Marshall Burnett and Chas. Vander Wœrd, Boston, Massachusetts.

Claim.—"So combining the punching bar with a vibrating lever at one end, and a cam at the other of it, as that it shall always rise and fall in a plane parallel to the bed of the machine."

99. For an *Improvement in Melodeons;* Jeremiah Carhart, City of New York.

Claim.—"The arrangement, in instruments operated by the exhaustion of air, of the reeds, valves, and hammers, in relation to the exhausting bellows or passage, so that the hammer is caused to operate outside of the influence of the bellows, and not between the bellows and the reed, and whereby the hammer may be readily detached and taken out of the instrument for repair, tuning, or adjustment of the reed without destroying the capability of the reed to speak or play. Without claiming the application of buffs, consisting of strips of leather, to musical instruments generally, or for any other purpose than that which I have specified, I claim their application to reed instruments, in connexion with the hammers."

100. For an *Improvement in Grain and Grass Harvesters;* J. Case, Springfield, Ohio.

Claim.—"Placing the line shaft directly above the vertical centre of the spur gear of the master wheel. Also, the adjustable anti-friction wheel, in combination with the spring and adjustable set screws."

101. For an *Improvement in Explosive Gas Engines;* Alfred Drake, Philadelphia, Pa.

Claim.—"1st, The igniting apparatus, composed of the thimble and the interior tube or blow pipe. 2d, The arrangement and combination of the hollow piston rod, piston, and jacket surrounding the cylinder, for the purpose of maintaining a constant circulation of water for cooling."

102. For an *Improvement in Lubricating Compounds;* N. Dresser, Rochester, N. Y.

Claim.—"The lubricating compound, and its application to journals, cranks, axles, and other machinery subject to friction."

103. For an *Improvement in Putting a Gas Generator in a Parlor Stove;* Solomon B. Ellithorp, Elmira, New York.

Claim.—"The combination of the coal stove and retort, making a portable coal gas generator."

104. For an *Improvement in Ship's Windlass;* James Emerson, Worcester, Mass.

Claim.—"The combination of the geared sectors with pawls attached, and the part with pinions, levers, and pulleys."

105. For an *Improvement in Processes for Melting Sugar;* Conrad William Finzel, Bristol, England; patented in England, May 7, 1853.

Claim.—"Melting the raw sugar in a vacuum, preparatory to the further refining thereof."

106. For an *Improvement in Dredging Machines;* Charles H. Fondé, Mobile, Ala.

Claim.—"The device for keeping the wheel in gear while raising and lowering, and the combination of the radius bar and the sliding carriage which carries the shafts of the pinion, and also moves the water wheels which slide on the feathered shafts, as this device and this combination of well-known mechanical devices is my own invention, and has enabled me to keep the excavating wheel always in gear with the engine, and has never been so applied before. Also, the self-acting latch in its particular form and mode of adjustment, it being so shaped and adjusted as to hold on to the lid of the bucket until it is struck by the tipper, and so balanced that by its own gravity it will fall over and latch again before the bucket enters the water; this particular form and adjustment, with the pin, does away with the necessity of springs, and is the result of careful and expensive experiments. Also, that particular combination of chutes or slice-ways which form an apex under the discharging tipper, and pass athwartships on an incline towards the screws, which particular combination has enabled me to discharge an excavating wheel laterally on either or both sides."

107. For an *Improvement in Grain and Grass Harvesters;* Eliakim B. Forbush, Buffalo, New York.

Claim.—"1st, The combination of the gear key with the gearing. 2d, The extension of the platform timber beyond the finger bar, so as to connect it to the main frame of the machine near the driving wheel, with the view of giving strength and stiffness to the platform, and bring its weight as much as possible on the main frame near the driving wheel. 3d, The locks, as improvements upon the clamp. 4th, The improvement of the second angle in the brace bar of the guard finger."

108. For an *Improvement in Moulds for Casting Pencil Sharpeners;* W. K. Foster, Bangor, Maine.

Claim.—"The arrangement of the spring holder and sliding plates, in relation to the grooved core and gauge, for the purpose of the adjusting and holding of the blade in the mould, and the forming of the slat in the pencil sharpeners."

109. For an *Improvement in Machines for Punching Metal;* DeGrasse Fowler and George Fowler, Wallingford, Connecticut.

Claim.—"The peculiar method of connecting the operation of the two levers to throw the machine out of gear at the time when the punch is at its greatest elevation."

110. For an *Improved Apparatus for Turning the Leaves of Music Books;* Isaac Gallup, Mystic Bridge, Connecticut.

Claim.—"1st, The employment and arrangement of the swinging bars and keys, in combination with said revolving self-adjusting pulleys or finger carriers. 2d, The employment of the spring I, in combination with the spring H. 3d, Providing a stop on each of the keys, and a spring catch on the under side of the top of the case, to fit against said stop. 4th, Providing each of the fingers with an extension."

111. For an *Improved Stud and Button Fastening;* Samuel W. Hopkins, Assignor to William C. Greene, John T. Mauran, and Charles Jackson, Providence, R. I.

Claim.—"The construction of the fastening, viz: having the shank of the stud or button formed of a tube which contains a spiral spring, and having a bar fitted in slots in the outer end of said tube and between the outer end of the spiral spring and a pin attached to the outer end of the tube; the outer side of the bar being provided with a recess, which, by means of the spring, is kept over the pin, and the bar consequently secured in a transversed position with the tube."

112. For an *Improvement in Rotary Engines;* Abraham Masson, Philadelphia, Pa.

Claim.—"The combination of the four steam cylinders and pistons with the curved guide, arranged and operating so as to produce a continuous rotary motion."

113. For an *Improved Fountain Pen;* Hugh K. McClelland, Eldersville, Pa.

Claim.—"The construction of the implement, viz: having a bag or receptacle placed

within a tubular handle, the lower end of said bag having a tube attached to it, which tube is provided with a valve and button or spur, the tube, valve, and button or spur being inclosed by the pen holder, which contains a sponge, and is provided with openings or channels through which the pen is supplied with ink as the valve is operated."

114. For a *Hay Making Machine;* Francis Peabody, Salem, Massachusetts.

Claim.—"1st, The machine for making hay, consisting essentially of the rake for gathering the grass, in combination with the revolving scatterer. 2d, Revolving the scatterer in a direction contrary to that in which the machine moves. 3d, The employment of a single wheel to carry and actuate the hay makers, when this wheel is placed in the centre of the machine."

115. For an *Improvement in Shut-off Valve Gear;* John B. Schenck, Ansonia, Conn.

Claim.—"1st, Connecting the slide valve with a lever, which is also connected at different points with two arms of unequal length, working side by side, and receiving motion from separate cams on the crank shaft of the engine, or some other shaft having a corresponding motion therewith, the whole operating to give the valve a double movement. 2d, Effecting the connexion between the finger wheel and the bevel wheel, or its equivalents, through which the said finger wheel transmits the movements of the governor to the cut-off cam, by means of pawls acting upon ratchet teeth, and providing a stud or stop on the opposite cam to that which carries the finger wheel for the purpose, when the cut-off cam arrives in position to give full steam for the whole stroke of the piston, of liberating the pawl, by which the motion is transmitted in the direction for retarding the operation of the cut-off cam, and thereby rendering it inoperative."

116. For an *Improvement in Horse Powers;* John Simpson, Atlanta, Georgia.

Claim.—"1st, The employment of the large or main vertical driving wheel without central bearings, in combination with the suspension band. 2d, In combination with the driving wheel without central bearings, and the suspension band, the inner run and the pulley, so arranged as to throw the foot of the driving wheel back."

117. For *Compensating Bearings;* Lewis Smith, Buffalo, New York.

Claim.—"Relieving bearings of machinery from undue pressure and consequent friction, by means of the different expansion of two or more different metals."

118. For an *Improvement in Making Printers' Ink;* C. A. Thompson, Adrian, Mich.

Claim.—"The composition of oil varnish, to be mixed with rosin, soap, lampblack, &c., for printers' ink."

119. For an *Improved Pen Holder;* William H. Towers, Philadelphia, Penna.

Claim.—"The combination of the sponge with the lever and pen."

120. For an *Improvement in Dies for Bolt Forging Machines;* John J. Willmarth, Northbridge, Massachusetts.

Claim.—"The tapering conical dies."

121. For an *Improved Paper Ruling Machine;* T. J. Baldwin, Bridgeport, Connecticut.

Claim.—"Lifting the pens from the sheets of paper at the proper intervals, by means of the mechanism, viz: having the front edges of the sheds, as they move along on the endless apron, strike against a pendant attached to a pulley on a transverse shaft on the frame, said shaft being provided with a pulley at one end having a recess or groove cut in its periphery, and a cam, the pulley, O, working on bearings on a pulley, M, underneath it, said pulley, M, being driven by a belt from the driving shaft; the cam operating a lever, by which the spring clutch is allowed to act and connect the pulleys at one end of the drum, the projections on the lower pulley, R, raising the pen stock so as to leave the blanks or spaces at the desired parts of the sheets."

122. For an *Improved Piano Forte Action;* Stephen P. Brooks, Suffolk, Mass.

Claim.—"Transferring the blow from the key lever to the hammer, by means of the vertical bar, whereby I am enabled to place the action below the level of the keys. Also, attaching the damper arm to the vertical bar in such a manner that the up and down movement of the said bar will alternately bring the damper against the string, and relieve it from the same. Also, the means used for keeping the hammer close to the string after the blow has been given, the same consisting of a nut attached to a vertical bar, and actuated by the key lever."

123. For an *Improvement in India Rubber Springs;* Wm. F. Converse, Harrison, O.

Claim.—"The method of confining a cylindrical or prismatic block of india rubber at all points of its surface, by means of a jointed or otherwise flexible cylindrical strap, connected to double levers, or their equivalents, for applying the compressing strain convergently or radially upon the inclosed rubber. Also, in this connexion, the adjustable end plates for securing the rubber from lateral expansion, and for graduating the elastic force of the spring, if desired, by means of screw nuts, or equivalent devices."

124. For an *Improved Arrangement of Rollers for Making Metal Tubes;* Martin R. Griswold, Watertown, Connecticut.

Claim.—"The arrangement of the adjustable smooth or serrated rollers whose axes cross each other, with the guide plate and slides, and guide rollers, for making seamless metal tubes."

125. For an *Improved Hay Press;* Pells Manny, Waddam's Grove, Illinois.

Claim.—"Having the followers arranged or placed so as to cross or intersect each other at right angles and inclined, and having the doors at each end of the box or case also inclined to correspond inversely with the followers, for the purpose of having the hay compressed in the form of square bales, the line of pressure being diagonally through the bale, or the followers and doors exerting the pressure on the four sides of the bale, whereby little or no pressure is exerted against the sides of the box or case."

126. For an *Improvement in Gas Cooking Stoves;* Andrew Mayer, Philadelphia, Pa.

Claim.—"The arrangement of the gas lamps or burners, with their overhanging perforated plates or openings, side apertures or passages for distribution of the heat oven, and hot air chambers or boxes situated at the sides of the oven within the body of the stove, and provided with lids and side valves."

127. For an *Improved Slide Rest for Lathes;* C. A. Noyes, Pittsfield, Mass.

Claim.—"Constructing the slide rest, viz: having the top of the sliding box rest upon a shaft, and inclining or tilting said top by means of the screw, toothed wheel, pinions, screw rods, and nuts, whereby the edge of the cutting tool, which is secured on the upper surface of the top, may be raised or lowered as desired, and presented in a proper position to the article to be turned."

128. For an *Improvement in Life Preserving Doors;* J. T. Pheatt, Toledo, Ohio.

Claim.—"The arrangement of the inflatable water proof coverings or bags, on or over the panels, and within, or below the face level of the surrounding and intermediate frame work of the paneled door or partition."

129. For an *Improvement in Cultivators;* John Stryker, Six Mile Run, New Jersey.

Claim.—"The application or use of front and rear supporters, which not only answer all the purposes of wheels, but regulate and govern the action of the coulters in the ground."

130. For an *Improvement in Grain and Grass Harvesters;* Philo Sylla, Elgin, Ill.

Claim.—"Hanging the sickle stock to the ends of the levers which carry it, by means of the hinges, or their equivalents, located at the diagonal corners of said stock."

131. For an *Improvement in Rotary Engines;* John J. Thomas, Manayunk, Penna.

Claim.—"1st, The attachment of a piston to a disk, which forms one side of the working cylinder or piston chamber, and works in contact with a bearing face on the cylinder outside of the piston, and another face inside of the piston. 2d, Constructing the engine with a central chamber within or surrounded by the working cylinder or piston chamber, and with another chamber on the opposite side of the disk which carries the pistons, and establishing communication between the chambers by a recess in the disk on one side of the piston and between the chambers, by an opening through the disk on the other side of the piston, either of the said chambers being the induction or suction chamber, and the other the eduction or discharge chamber, and the said chambers supplying the cylinder and receiving its discharged contents."

132. For an *Improved Slide Rest for Lathes;* Chester Van Horn, Springfield, Mass.

Claim.—"Forming the tool block of two parts, and connecting said parts, *c* and *d*, together by a dove-tail, or its equivalent, so that the upper part may slide or work on

the lower part, the faces of the two parts that are connected being oblique or inclined, and the part, *c*, being moved or operated by a screw, or its equivalent, for the purpose of elevating or depressing the tool."

133. For an *Improvement in Metallic Hones;* Wm. H. Webb, Jr., Chelsea, Mass.

Claim.—" A hone, constructed with its sharpening surface composed of a combination of metals of different degrees of density, and arranged together."

134. For an *Improved Furnace for Locomotives;* O. W. Bayley, Assignor to Manchester Locomotive Works, Manchester, New Hampshire.

Claim.—" The arrangement of the compartments communicating with each other by the opening, and with the combustion chamber by the openings, whereby the unconsumed gases from the freshly fed fire are heated by passing over the whole length of the incandescent fire, and consumed in the chamber."

135. For an *Improvement in Rakes;* Henry Chalfield, Assignor to self and Theodore L. Snyder, Waterbury, Connecticut.

Claim.—" Constructing the teeth or tines of a rake or fork separately, with square or an equivalent form of apertures through the heads thereof, and uniting them by a single bolt accurately fitting and passing through all the said apertures, and through a similar aperture in the shank of the instrument, the teeth or tines being kept at suitable distances apart by washers or blocks placed upon the bolt between them, or by enlarging the heads thereof, for the same purpose, the whole being secured firmly together by a nut screwed upon the end of the bolt, or in any other suitable manner."

136. For an *Improvement in Folding Tops for Carriages;* William G. Foglesong, Assignor to self and Benjamin D. Anderson, Xenia, Ohio.

Claim.—" The application of a catch, or its equivalent, in front of the hinge which unites the principal bow or slat iron to the stem, for the convenient stretching, &c., of a carriage or buggy top."

137. For an *Improvement in Propellers;* Wm. D. Jones, Poughkeepsie, New York, Assignor to Henry Whinfield, City of New York.

Claim.—"The arrangement and combination of the parts forming a propeller."

138. For an *Elastic Tube Pump;* Rufus Porter, Washington, D. C., Jonathan D. Bradley, Assignors to Jonathan D. Bradley, Brattleboro', Vermont, and George Dennison, City of New York.

Claim.—" 1st, The mode of equalizing the resistance by a truncated cone of gradually diminishing thickness, by which the roller may leave the tube, in combination with a lift below. 2d, The relieving the spring of the tube and the allowing the water to recede by means of jointed arms, eccentrics or cams. 3d, The mode of attaching the tube to the helical bands, by means of forming the latter in two parts, and by means of a bead or moulding on the former."

139. For an *Improvement in Sewing Machines;* E. Harry Smith, City of New York, Assignor to the Wheeler & Wilson Manufacturing Company, Watertown, Conn.

Claim.—" A discoidal shuttle, having its bearings in its periphery, and revolving around its own axis. Also, as a means of propelling the shuttle, the employment of the lune form button, which has a movement on its axis, for the purpose of allowing the thread to slip alternately into and out of the concave in its periphery, and thus pass off the shuttle."

140. For an *Improvement in Cast Iron Pavements;* George Neilson, Assignor to self and Nehemiah Hunt, Boston, Massachusetts.

Claim.—"Making a paving block with a perimeter of thirty faces, and formed by sixteen hexagons or hexagonal prisms, disposed with respect to one another, the same enabling such block, where it abuts against a contiguous block when laid in a pavement, to be supported laterally by a semi-hexagonal projection and recesses."

APRIL 24.

141. For an *Improvement in Platforms of Grain and Grass Harvesters;* Jearum Atkins, Chicago, Illinois.

Claim.—" The bars or ribs, or their equivalents, on the platform of reapers in rear of

the knife, in combination with a rake actuated by hand or by machinery, and moving above the platform, the ribs being either straight or curved, but parallel or nearly so to the travel of the teeth of the rake."

142. For an *Improvement in Spring Connecting Rods for Washing Machines;* Jason W. Corey, Crawfordsville, Indiana.

Claim.—"The coiled spring, combined with the eccentric, or its equivalent."

143. For an *Improvement in Stoves, &c.;* J. Johnson and J. E. Crane, Lowell, Mass.

Claim.—"The employment of the valve, in combination with the bridge."

144. For an *Improvement in the Manufacture of Slate Pencils;* Norman C. Harris, Poultney, Vermont.

Claim.—"Cutting the pencils, completely formed, from slabs of slate, by means of a cutter or series of cutters, grooved so as to half form the pencils on one side of each slab, and then reversing the slab, and forming the other halves of the pencils."

145. For an *Improvement in Implements for Shearing Sheep;* Palmer Lancaster, Burr Oak, Michigan.

Claim.—"The construction of the implement, viz: having a series of cutters, *f*, work over a series of stationary cutters, *h*, the cutters, *f*, having a vibratory movement given them by means of the reciprocating frame rack, pinions, F F, with pawls attached to them, and spur wheel, pinion, H, and crank pulley, the pinions, F F, being placed loosely on the shaft of the spur wheel."

146. For a *Machine for Feeding Paper to Printing Presses;* Isaac B. Livingston and Miles Waterhouse, Barnet, Vermont.

Claim.—"The use of the angular guide ways, in combination with the cross bar, or its equivalent. Also, the use of the crank, or its equivalent, working between the arms of levers, in combination with levers and cross bar. Also, the raising table, in combination with the cams, shafting and gearing, (for moving said table,) or their equivalents. Also, the combination of machinery for carrying forward the paper, a sheet at a time, and feeding it to printing presses."

147. For an *Improvement in Looms;* John G. Melville and W. Brayshaw, Wetheredville, Maryland.

Claim.—"In combination with a vibrating bar or lever, one or more segments, whose perimeters are partially provided with cog and partly with ratchet teeth, for the purpose of operating the shuttle boxes of figuring looms through the intervention of a straight rack, so that we dispense with several of the pieces heretofore used, and thus cheapen and simplify the mechanism, whilst the same ends are attained as by the more complicated machinery at present used for this purpose."

148. For an *Improved Piano Forte Action;* William Munroe, Boston, Massachusetts.

Claim.—"1st, The combination of the escapement jack and check, co-operating to sustain the hammer in position, to repeat, and prevent its rebound. 2d, The inclined escapement, as applied to piano forte and other similar actions. 3d, The application of the toggle joint to piano forte and other actions, in combination with the jack and hammer."

149. For an *Improvement in Carriage Springs;* Thos. Murgatroyd, Jr., Smithville, Canada West; patented in Canada, July 21, 1854.

Claim.—"The employment or use of the springs attached to the arms of the axles, by links, *b*, *d*, the links, *b*, being above, and the links, *d*, below the arms of the axle, the two springs being connected by stays or rods. The springs being also braced to prevent a forward and backward motion of the same, and the axles being supported or braced by the rod or brace."

150. For an *Improvement in the Combined Table and Writing Desk;* Lucius Page, Cavendish, Vermont.

Claim.—"The combination of the desk recess and the hinged box or case with the table, so as to operate therewith. Also, the combination of a reversible paper rack with the hinged box or case, provided with two sets of doors on its opposite sides, and adapted to a table so as to fold into and out of the same."

151. For an *Improvement in Machines for Polishing Stone;* Louis S. Robbins, City of New York.

Claim.—"The manipulating apparatus, (consisting of the shaft, crane, radial arm, and wheel,) in combination with the revolving and self-adjusting rubber or polisher."

152. For an *Improvement in Machines for Planing Metal;* James H. Thompson, Paterson, New Jersey.

Claim.—"1st, Planing the sides of nuts of prismatic bars, by means of a series of cutters attached to the periphery of a disk of scroll form, so that each cutter will project a trifle further from the centre or shaft of said disk, and thereby allow the whole number of cutters to pass over and plane the whole surface of each side of the nuts or bar at one revolution of the disk. 2d, The employment or use of the disk, with cutters attached to its periphery, in combination with the intermittingly rotating mandrel. 3d, Rotating the mandrel intermittingly, by means of the lever projection attached to the disk and the ratchet and drum, operated by a weight, or its equivalent. 4th, Operating the clutch by means of the radial arms, P, lever, and spring attached to the sliding bar, the arms, P, being acted upon by the arm, W, on the shaft."

153. For an *Improvement in Attaching Wheels to Harvesters and other Machines;* Abner Whiteley, Springfield, Ohio.

Claim.—"The simultaneous attachment of the wheel to or on the axle, and the axle to the plate, by means of the bolt, in combination respectively with the stud and washer."

154. For *Improvements in Harvesters;* Abner Whiteley, Springfield, Ohio.

Claim.—"1st, The arrangement of reel, cutting apparatus, and platform, all oblique to the line of draft or reel, acting obliquely over any platform, or any other substantially equivalent device, whereby the grain is at once reeled down, cut, and conveyed over the platform in a continuously straight line, and at the same time delivered at a sufficient distance from the standing grain to permit the passage of the horses between it and the cut grain when cutting the next swath. 2d, So placing the reel that the reel rods will strike the grain when they enter it, outside of the line passing through the point of the divider, and parallel to the line of draft. 3d, Placing the grain wheel in a plane intersecting the line of draft, so that it may relieve or counteract the side draft. 4th, Placing the axis of the grain wheel (when so located in a plane intersecting the line of draft,) in a plane which passes vertically through the centre of the master wheel, so that it may at the same time give ease in turning at the corners. 5th, The combination of the metal groove and the sickle, (the length of which is that of the cut of the machine,) for the purpose of enabling me to place the grain wheel opposite the end of the sickle, and at the same time with its point of bearing on the ground within the space cleared by the divider. 6th, The longer and divergent finger next to the divider. 7th, The sickle tooth, serrated on the smooth side and beveled on the other. 8th, The alternate spaces in the rear of the sickle bar and teeth, combined with the shoulders on the fingers against which the sickle bar works, for the purpose of alternating the bearings, &c. 9th, The cone on the knee lever. 10th, The combination of the rake, swinging from one arm of the reel, with the springplate guides, by which, when the rake has delivered the grain at the end of the platform, it is prevented from swinging back and coming in contact with the falling grain."

155. For an *Improvement in Forge Hammers;* John Comstock, New London, Conn., Assignor to Peter Naylor, City of New York.

Claim.—"1st, The method for regulating the speed of the blows given by a forging hammer, by the use of a tightening pulley, combined with the brake applied to the fly wheel. 2d, The method for regulating the amount which a hammer is drawn down to give the blow by rotating cams, by combining with said cams and hammer the adjustable screw shackle and lever."

156. For an *Improvement in Machines for Dressing Lawns;* R. L. Hawes, Worcester, Massachusetts, Assignor to Robert Rennie, Lodi, New Jersey.

Claim.—"The stationary heating cylinder, in combination with the hoops, having an alternate intermittent revolving motion. Also, the sectional roll, in combination with the rollers, for the purpose of drawing the selvages alternately from the machine."

ADDITIONAL IMPROVEMENTS.

1. For an *Improvement in Pen Holders;* E. W. Hanson, Philadelphia, Pennsylvania; dated April 10, 1855; original patent dated Dec. 6, 1853.

Claim.—"Constructing the thumb and finger rests, or either of them, so that they shall extend along the sides of the cylinder a greater or less distance, whether the outer corners of the same be rounded off or left full, or whether the said cylinder be adapted for fitting over the pen barrel or tube, or for attaching to the end of the stick, so as to dispense with the barrel or tube, or whether the said rests be soldered to the cylinder or cut out with the same."

2. For an *Improvement in Saddle Trees;* Wm. E. Jones, U. S. Army; dated April 17, 1855; original patent dated June 13, 1854.

Claim.—"The combination with the hinged pommel and cantle, of the self-adjusting side pieces, for the purpose of preventing an unequal pressure upon the edges of the side-pieces, however much the saddle tree be expanded or contracted."

RE-ISSUES FOR APRIL, 1855.

1. For an *Improvement in Vault Covers;* Thaddeus Hyatt, City of N. York; original patent dated Nov. 12, 1845; re-issue dated April 3d, 1855.

Claim.—"Making covers for openings to vaults in floors, decks, &c., of a metallic grating, or perforated metallic plate, with the apertures so small that persons or bodies passing over or falling on them may be entirely sustained by the metal, when the apertures are protected by glass. Also, in combination with the grating or perforated cover and glass fitted thereto, the knobs or protuberances on the upper surface of the grating or perforated plate, for preventing the abrasion or scratching of the glass."

2. For an *Improvement in Grain and Grass Harvesters;* Abner Whitely, Springfield, Ohio; original patent dated Sept. 19, 1854; re-issue dated April 3d, 1855.

Claim.—"1st, The combination of the rake, swinging or suspended from one rod of the reel, with the guides and ways, for the purpose of not only delivering the grain at the rear of the platform, but also for better directing the standing crop to the cutters. 2d, The guides for forcing the grain into the end of the reel. 3d, The latch and appendages, by which the operator is enabled to permit more or less grain to accumulate on the platform between successive actions of the rake. 4th, Placing the vibrating knife bar and cutters thereon, between alternately placed fingers, for the purpose of dispensing with the slot guards, and sustaining the line of cut by throwing the action of the alternate shear edge of the blades of said cutters on the upper and lower sides of the said fingers. 5th, The alternate edging of the same tooth, and so placing them together that the two adjacent edges of successive teeth, which act against the same finger, may be alike turned in one direction, while the next two edges, acting against the next finger, are alike turned in the contrary direction."

3. For an *Improvement in Grain Harvesters;* Aaron Palmer, Brockport, N. York, and Stephen G. Williams, Janesville, Wisconsin; original patent dated July 1, 1851; re-issue dated April 10, 1855.

Claim.—"Discharging the cut stalks and heads of grain from the main platform, on which they first fall, by means of the combination of the rake with the overhung lever, moved by gearing located within the inner edge or circle of said platform."

4. For an *Improvement in Winnowing Machines;* Benjamin D. Sanders, Holliday's Cove, Va.; original patent dated June 19, 1849; re-issue dated April 10, 1855.

Claim.—"1st, The employment or use of a vertical blast spout, gradually enlarged from its lower to its upper end, so that the strength of the blast is decreased in the upper portion of the spout, owing to the increased space or area of the spout, for the purpose of preventing any sound or perfect grain being carried with the light foreign matter, over the upper edge of the spout, the blast being formed or generated in said spout in any proper manner. 2d, The blast spout, either gradually enlarged from below upwards, or of the same dimensions throughout, and communicating with the atmospheric current through the screen, in combination with the hopper, and the fan placed at the end of the opposite vertical spout to separate the chaff and other impurities from the grain.

3d, The employment or use of a vertical blast spout, either gradually enlarged from below upwards, or of the same dimensions throughout, when said blast spout is so arranged that the grain is cleaned or separated from impurities within said vertical spout."

5. For an *Improvement in Hinge of Rolling Iron Shutters;* A. Livingston Johnson, Baltimore, Md.; original patent dated June 25, 1850; re-issue dated April 24, 1855.

Claim.—"Constructing shutters of slats of sheet metal, with joints formed by curving the edges of the slats, and securing them in place in the manner specified, viz: either by turning down projections from, or attachments to the ends of the slats, and thus forming an even edge to the shutters, or by means of wires inserted in the curves and bent or headed at the ends, the shutter sliding up and down in the grooves of the window frame in which it is placed."

6. For an *Improvement in the Construction of Moulds for Pressing Glass;* Hiram Dillaway, Sandwich, Massachusetts; original patent dated August 21, 1841; re-issue dated May 1, 1855.

Claim.—"So combining with a mould fountain or reservoir provided with a plunger, one or more matrices or moulds, that a liquid mass of glass, when pressed in said fountain or reservoir by the plunger, may be made to flow or pass therefrom and into such matrix or matrices. Also, combining with a series of matrices and a press chamber or reservoir surrounded by them, an auxiliary annular and concentric chamber formed in the two mould plates, and made to perform the function of preventing the plunger from clogging the mouths of the matrices, under circumstances as above stated, and also to prevent the chilled glass from obstructing the downward movement of the plunger. Also, so combining with the lower mould plate or movable bottom block, that the same may not only serve to form a bottom to the main and auxiliary mould chambers, or to the former, but also enable a person to detach the pressed glass or metal from the lower mould plate."

Designs for April, 1855.

1. For *Handles of Forks and Spoons;* Henry Biggins, Mount Vernon, New York, Assignor to Michael Gibney, City of New York; dated April 3, 1855.

Claim.—"The ornamental designs, with the handles of forks and spoons, and other articles of table cutlery."

2. For *Spoons;* John Graham, Providence, Rhode Island; dated April 10, 1855.

Claim.—"The ornaments and the beads with their scrolls."

3. For *Clock Fronts;* Wm. B. Lorton, City of New York; dated May 1, 1855.

Claim.—"The design and configuration of the casting, forming the front and sides of a clock case."

4. For *Cooking Stoves;* George Warren, S. H. Sweetland, and E. C. Little, Crescent, New York; dated May 1, 1855.

Claim.—"The ornamental design of cook stove plates."

5. For *Water Coolers;* Garretson Smith, Henry Brown, and Joseph A. Read, Assignors to James G. Abbott and Archilus Lawrence, Philadelphia, Pa.; dated May 1, 1855.

Claim.—"The design and arrangement of the castings, and the ornaments in bas-relief thereon."

MECHANICS, PHYSICS, AND CHEMISTRY.

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*Object of Salt in the Sea.**

At a recent meeting of the Canadian Institute, a very interesting paper was read by Professor Chapman, of University College, Toronto, on the "Object of the salt condition of the Sea." Professor Chapman began by assuming that the sea was created salt from the beginning,

* From the Lond., Edin. and Dub. Philos. Mag., March, 1855.

and for some beneficent purpose; and then proceeded to discuss the views hitherto advanced in elucidation of this object. The suggestion, that the sea is salt in order to preserve it in a state of purity, was considered to be untenable for several reasons; mainly, however, from the fact, that organic impurities when diffused through a vast body of moving water, whether fresh or salt, become altogether and very rapidly lost; so much so, indeed, as apparently to have called forth a special agency to arrest the total annihilation of organized matter in its final oscillation between the organic and inorganic worlds. The author alluded to the countless hosts of microscopic creatures which swarm in most waters, and whose principal function has been ably surmised by the great anatomist, Professor Owen, to be that of feeding upon, and thus restoring to the living chain, the almost unorganized matter diffused through their various zones of habitation. These creatures preying upon one another, and being preyed upon by others in their turn, the circulation of organic matter is kept up, and carried through its appointed rounds. If we do not adopt this view, we must at least look upon the Infusoria, the Foraminifera, and many of the higher types, as scavenger agents appointed to prevent an undue accumulation of decaying matter; and thus, as before, the salt condition of the sea does not become a necessity. It was shown also, that, under many circumstances, the amount of saline matter in the sea is not sufficient to arrest decomposition. Other suggestions, to the effect that the sea is salt in order to render it of greater density, and by lowering its freezing point to preserve it from congelation to within a shorter distance of the poles, were then discussed in their more prominent relations. The value of these suggestions in a secondary point of view was fully admitted, but shown, at the same time, to be scarcely adequate to meet the entire solution of so vast and grand a problem as that which is manifestly involved in the salt condition of the sea. The freezing point of sea water, for instance, is only $31\frac{1}{2}$ F. lower than that of fresh water; and hence with the present distribution of land and sea,—and still less, probably, with that which obtained in former geological epochs—no very important effects would have resulted had the ocean been fresh instead of salt. So far as regards the habitable portions of the world, the present difference would be next to nothing. Professor Chapman here submitted to the Institute a suggestion which he believed to be original, in reference to the question under discussion. He considered the salt condition of the sea as mainly intended to *regulate evaporation*, and to prevent an undue excess of that phenomenon under the influence of any disturbing causes that might from time to time arise. It is well known that under the same atmospheric pressure different liquids have very different boiling points; and in like manner, saturated solutions evaporate more slowly than weak ones, and these latter more slowly again than pure water. In sea water we have on an average about $3\frac{1}{2}$ per cent. of solid matter, of which about 2·6 consists of chloride of sodium or common salt. The results of certain experiments by the author in reference to evaporation on weighed quantities of ordinary rain-water, and water holding in solution 2·6 per cent. of salt, were then given. The excess of loss of the rain-water over the water of the salt solution was, for the first twenty-four hours, 0·54 per cent.; at the close of forty-eight hours, 1·04 per

cent.; after seventy-two hours, 1·46 per cent., and so on, always in an increasing ratio; the experiments in each case being carried on for six days.

Here, then, we have a self-adjusting phenomenon, one of those admirable contrivances in the balance of forces, which an attentive study of nature reveals to us in every direction. If, other conditions being equal, any temporary cause render the amount of saline matter in the sea above its normal value, evaporation goes on the more and more slowly; and, on the other hand, if this value be depreciated by the addition of fresh water in undue excess, the evaporating power is the more and more increased—thus aiding time, in either instance, to restore the balance. In conclusion, the author pointed out that the consideration of this principle might shed some further light on the geographical distribution of fresh and salt water lakes on the present surface of the globe.

For the Journal of the Franklin Institute.

Chemical Examination of the Bakers' Bread of Philadelphia. By Charles M. Wetherill, Ph. D., M.D.

Bread is the most important element of our food, not only for its nutritive properties, but because it is susceptible of adulterations, which, though they may be small in amount, are nevertheless so constantly taken into the system that they cannot fail in the end to prove detrimental to health. We find accordingly a very general prejudice against the wholesomeness of bakers' bread, and the fault is attributed to the use of alum, which is supposed to be the reason that such bread presents a finer appearance than that made at home. Although this is a vulgar error, since such fine appearance is the result of art, and the bread need not contain any different ingredients from that which is home-made, bakers have thrown themselves open to suspicion, for wherever the bread has been examined on a large scale, adulterations have been found present, and, in some places, are of universal use. Mr. Normandy, author of the *Commercial Hand Book of Chemical Analysis*, states in the same work that "bread really pure, that is, made altogether of genuine wheat flour, is, without doubt, to be found no where in London;" in all the samples of bread examined by him, with but one exception, alum was detected, and in that exception, like the others, a certain quantity of potato flour or pulp was found.

Liebig in his Chemical Letters* states, that he saw in an alum factory in Scotland, small mountains of finely ground flour of alum for the use of the London bakers. In the same work he gives an explanation of the mode in which alum acts upon the bread, and why it is used by the bakers. When the millers moisten their grain in order to facilitate the grinding and do not subsequently dry the flour, or when the flour is exposed to the moisture of the atmosphere, the gluten acts upon the starch to form acetic and lactic acids, which render the gluten soluble in water, which it is not originally; the dough from such flour does not rise well, and the resulting bread is heavy and of bad appearance. Several salts

* P. 541 of Third German Edition.

act chemically upon the altered gluten of such flour and render it insoluble again, so that the resulting bread becomes white, elastic, light, and as if made from the best of flour and capable of retaining more water, yielding, consequently, more bread from a given quantity of flour. The salts which produce this effect and which are used more or less as adulterations, are alum, subcarbonate of magnesia, sulphate of copper, and sulphate of zinc. The use of blue vitriol by bakers in the north of France and in Belgium, has been abundantly proved, as may be seen by a reference to Ure's Dictionary. Carbonate of magnesia, if it be not in too great an excess, cannot be regarded as injurious. Liebig has recently made some experiments upon the use of lime water in the baking of bread, and found that five pounds of a saturated solution of lime water for every 19 lbs. of flour, gave a bread of fine appearance, and which he deems more wholesome than if made by any other process, as such treatment supplies to bread the deficiency of lime which places it below peas and lentils in nutritive power.* He proposes therefore to substitute the harmless lime water, which acts in a similar manner, for the injurious adulterations in frequent use.

The above mentioned substances being used to make a fair looking bread from damaged flour and to cause it to retain a greater weight of water, another class containing chalk, plaster, lime, clay, &c., is employed sometimes, but I think rarely here, and which acts in increasing the weight of the bread; these cannot be added to any great extent without injuring its appearance, and are readily detected by the quantity of ash yielded by incineration. Finally, potatoes, starch, &c., are added in some places to the flour, and do not act injuriously to the health, although they diminish from the nutritive power (for relative weight) of the bread, and may be regarded as adulterations when the loaf is sold at the same price as the same weight of pure wheat bread. Salæratus with the acids or salts used to liberate the carbonic acid, are only injurious when in excess in the bread; they act economically in affording the carbonic acid which puffs up and renders porous the bread, and which would otherwise have to be supplied by the flour itself by the action of the yeast.

I am not aware whether an extended examination of the bread for adulterations has been made in any of our cities, and it seemed interesting as well as important to ascertain whether we are furnished with a pure article, or if in any other respect an advantage is taken by the bakers over the consumers of bread. It was expected that a careful examination of the bread of 24 bakers taken indiscriminately from all classes of bakeries, and from different parts of the city, would supply the desired knowledge, and I am happy to be able to say, that although adulterations are employed in a very few instances, our bread is generally pure. It is gratifying to learn this, and although manifest reasons prevent publishing the names of these delinquent bakers in this article, there is a law to reach them, and I am ready at any time to give their names to the proper authorities.

It was important to adopt a plan which should not occupy too much time for the examination, as the bread had to be purchased by single

* Liebig calculated the amount of lime in such bread, and finds it equal to what is naturally present in the seeds of the Leguminosæ.

loaves each day. Accordingly some preliminary experiments were made to settle upon the most expeditious method, and to test its accuracy by the examination of bread to which the adulterations had been purposely added. The method of Messrs. Robine & Parisot, consisting in soaking the crumb in water, filtering, and after evaporation, testing the aqueous solution of the residue, was rejected on account of its slowness; the filterings and pressing through linen render it difficult to get a clear solution for testing, with as much speed as by other methods. Incineration was therefore resorted to. It is important, not so much for analyses like the present as for those of agricultural and animal chemistry, to be able to obtain the ashes of vegetable and animal matters with little trouble and without losing any of their important ingredients. Perhaps the best method in use, is that of Erdmann & Strecker by the muffel, in which by the aid of a very low heat during 12 hours the dried substance is reduced to an ash of the required purity for analysis. It is rather troublesome to keep up the proper heat for so long a time, and difficult to avoid some of the ashes of the combustible mingling with those of the substance under treatment. An effort was made to substitute gas heat, which answered admirably, and which I would recommend in the preparation of ashes where gas can be obtained. Among the gas burners in use in my laboratory, is one composed of three concentric rings of $\frac{1}{4}$-inch brass tubing, the outer ring having an outside diameter of $2\frac{1}{2}$ inches and $\frac{1}{4}$-inch of space being between the rings. These rings are attached to a cross tube which delivers gas to them, and they are pierced with about 26 holes half an inch apart, and have a cylindrical or conical chimney of $6\frac{1}{2}$ inches height and of diameter at base $3\frac{1}{2}$ inches; this lamp gives an intense heat, and may be converted into a gas stove burning mixed gases, by placing a wire gauze cap upon the chimney, and igniting the gas above. This burner with the cylindrical chimney as a gas stove, was employed in the incinerations. If a large platinum dish ($4\frac{3}{4}$ inches diameter) be placed, resting on the wire gauze, it will be bathed in flame and kept at a full red heat if necessary. Two hundred grammes of dried bread could thus by a low red heat lose their combustible gases and be reduced to coal in a few minutes; this coal was then transferred to the muffel, where the incineration was completed in 6 or 7 hours. The muffel is prepared in the following way. An ordinary muffel of the dimensions $4\frac{1}{2} \times 3 \times 9$ inches, has two pieces cut from it, one at the roof and back, in which a small stove pipe of one foot height by $1\frac{1}{2}$ inches diameter is fitted, and the other in the middle of the bottom, and which is just large enough to admit the top of the cylinder of the gas stove with the wire gauze cap. A platinum tray of dimensions somewhat less than the inside of the muffel and which has its two sides bent up, serves to hold the substance to be incinerated; this is protected from the direct action of the heat, which would be too great for the incineration, by a stand of sheet iron elevated one inch above the floor of the muffel, the feet of which are made by bending down the front and back of the iron, and the sides are also bent up to correspond with the sides of the platinum tray. The dimensions of this part of the apparatus are such, that from $\frac{3}{8}$ to $\frac{1}{2}$ an inch of space is allowed on each side of the tray for the passage of the flame. The muffel is supported over the gas burner at such a distance as to yield the

most heat. More heat than is needed may be obtained by the apparatus, and when once started, no further care is required until the operation is completed. A draft over the surface of the ash is created by the chimney.

The plan adopted for the examination was to purchase every morning at the same hour of the day, a four cent loaf of fresh bread, noting the residence of the baker. It was at once weighed, cut into slices, and 200 grammes (or about 7·05 ounces, and which generally employed almost all of the loaf) placed in the gas thermostat to dry at 100°C. By the next morning it was perfectly dry, (a portion heated in a tube gave no aqueous deposit on the glass,) and was weighed again to determine the per centage of dry bread in the loaf; the whole of the dry bread was broken into pieces of an inch and heaped up in the platinum dish, where it was carbonized, and in ten minutes its bulk so reduced, that it could all go upon the platinum tray in the muffel where the incineration was completed. The ash was then weighed, placed aside in bottles, and the apparatus cleaned for the next incineration. In thus preparing the ash, not more than half an hour was employed each day in performing all the operations, including the cleaning of the platinum vessels. I determined in one experiment the amount of substance adhering to the platinum vessels, to ascertain what error it would give in the per centage calculation of the ash; the amount was 0 043 grammes, or only $\frac{2}{100}$ of a per cent. for the bread as it comes from the bakers. I also determined the silica and coal in four specimens of ash; the silica, which comes principally from the material abraded from the millstones, for curiosity, and the carbon in order to ascertain the error it would cause in the ash determination, which it was important to know, as certain adulterations are detected by the weight of the ash. The darkest specimens of ash were purposely selected—(*a*,) 2·393 ash, from 200 grms. bread, in which alum had been placed by the baker, gave silica 0·0332 and coal 0·0298; (*b*,) 2·103 ash, from 200 grms. bread, to which 0·0066 sulphate of copper had been purposely added, gave silica 0·0327 and coal 0 0223; (*c*) 2·594 ash, from 200 grms. bread, to which 0·22 alum had been purposely added, gave silica 0·0287 and coal 0·0133; (*d*) 2·227 ash, from 200 grms. of pure bread, gave silica 0·0687 and coal 0·0213. The per centage of coal and silica calculated for the original weight of the bread, is as follows:—

	Coal.	Silica.
(*a*)	0·014	0·016
(*b*)	0·011	0·016
(*c*)	0·006	0·014
(*d*)	0·010	0·034

The coal, therefore, which may remain in the ash under the most unfavorable circumstances does not influence the accuracy of the ash determination.

Before proceeding to the analysis of the ashes, some preliminary experiments were performed upon bread to which adulterations in the smallest quantity that they can be used for the best effect, were added in solution in water to the weighed bread before placing it in the thermostat. Examinations of the reagents used in the experiments for the substances sought after were also made. The chlorate of potassa and caustic potassa, yielded a small precipitate when neutralized by hydrochloric acid and pre-

cipitated by ammonia; this proved to be carbonate of lime. The caustic potassa, which was sold for chemically pure, contained platinum. The bread designated by No. 4, in the table which is to follow, having been tested several different times and found pure, was used in the experiments of adding sulphate of copper and alum.

(A) To 200 grms. of bread, 0·263 of crystallized sulphate of copper and 0·22 of alum crystals dissolved in water were added before drying the bread in the thermostat. The ash had a green tinge. The hydrochloric solution of the residue left by treating the ash with water, was boiled with caustic potassa and filtered; in the filtrate, alumina was detected by neutralization by HCl and the addition of ammonia. The precipitate by potassa when heated with ammonia and carbonate of ammonia, gave a blue filtrate containing copper.

(B) To the same portion of the bread from another day's baking, 0·0066, sulphate of copper was added in the same manner; the ash was still decidedly greenish in places; the precipitate from the hydrochloric solution by potassa was treated as in (*a*) with the same results, the ammoniacal solution was blue and gave a black precipitate by *sulphuretted hydrogen.*

(C) The same bread containing 0·22 alum to 200 grammes, treated in the same way, gave a precipitate of alumina.

(D) To bread from the same bakery, the same quantity of alum as in (C) was added, and alumina detected in the same manner as before; the residue from the boiling with caustic potassa, was boiled for a considerable time with fresh potassa, which took up an additional minute quantity of alumina. The part of the ash insoluble in hydrochloric acid was fused with bisulphate of potassa, and in it a very small quantity of alumina detected. The alumina from the potassa solution weighed 0·0235. By a direct experiment upon the alum employed, 0·22 grammes $+HCl+NH_4O$ gives 0 0322 of alumina.

(E) contained 0·22 alum to 160 grms. The ash was boiled with acetic acid, water added, and filtered; the portion insoluble in the acid was fused with bisulphate of potassa, and the alumina precipitated therefrom in the usual manner; it weighed 0·518; the acetic solution contained no alumina.

(F) a specimen of the same bread, containing 0·22 alum to 200 bread, was treated by the addition of nitric acid to the ash, evaporating to dryness and taking up with *water;* the evolution was boiled with 20 cubic centimetres of strong potassa solution, from which, after filtration, the alumina was precipitated. The residue, after boiling with hydrochloric acid and sulphite of soda according to Fresenius' method, was boiled with 10 CC of the potassa solution and the alumina precipitated, using the precaution to destroy the organic matter in the potassa from the filter by chlorate of potassa. These two portions of alumina united weighed only 0·0178; the loss may be accounted for by not having added a little acid to the residue after it had been evaporated to dryness. Upon these experiments the method employed in the general examination was based, the ash was treated with water and a certain quantity of nitric acid added; if effervesence took place to any great extent, the presence of

salæratus or compounds containing it was inferred, for the ash of pure bread, though alkaline with water from the presence of phosphates, does not effervesce with acids. It was then evaporated to dryness, more nitric acid added, water, and the filtrate after being reduced by sulphite of soda, was boiled for a quarter of an hour with caustic potassa, which, on being neutralized after filtration by hydrochloric acid, was boiled with a little chlorate of potassa, and then neutralized by ammonia and suffered to stand in a warm place for 24 hours to detect alumina. This precipitate of alumina was tested before the blow pipe with nitrate of cobalt, and the blue color distinctly obtained. It is sometimes difficult to perform this experiment upon charcoal, owing to losing the substance when it is small in quantity or powdery, by the blast. This may be obviated by moistening it with the cobalt solution on the coal and heating it gently until it cakes together, and then transferring it to the little platinum blow-pipe spoon, where it may be heated without any danger; it is not well to treat it at once in the spoon with cobalt, as the platinum is blackened thereby, and the blue color not so easily seen. The precipitate from the caustic potassa was re-dissolved in hydrochloric acid and re-precipitated by ammonia and carbonate of ammonia; the filtrate from this precipitate was concentrated, and the blue color looked for. It was then neutralized by hydrochloric acid and saturated by sulphuretted hydrogen; this of course produced a precipitate in every case owing to the platinum in the potassa, (in the precipitate from the ammonia, platinum could also be detected). The sulphuret was, therefore, boiled with hydrosulphuret of ammonia and the residue tested for copper by solution in nitric acid, evaporation to dryness and development of the blue color with ammonia, and precipitation of metallic copper by iron. In the bread where copper was detected, the test was perfectly plain and unmistakable. In one or two other specimens of bread hydrosulphuret of ammonia left an extremely minute dark residue, but which did not give the blue color with ammonia. The precipitate of the phosphates of the alkaline earths by ammonia, contained the magnesia if any had been added as carbonate to the bread. My attention was directed particularly to this base in testing for alumina. In the case of No. 15, an abundant crystalline precipitate of phosphate of magnesia and ammonia (which was analyzed) fell on the addition of ammonia, and Nos. 22 and 23 yielded a small quantity of the same salt on standing. The precipitates of the phosphates of the alkaline earths were examined by solution in hydrochloric acid, precipitation by ammonia filtering, boiling with carbonate of ammonia, and the magnesia tested in the filtrate by phosphate of soda, and in several instances, this base was detected. In some of these cases, the magnesia so detected, may be naturally in the bread, although the phosphate of magnesia would, it seems, be separated by the ammonia, but in others it was purposely added, judging from the quantity.

These analyses were all performed in the same way, in similar vessels and with measured quantities of the reagents; the same quantity of each of the reagents was treated like the substance under examination for the avoiding mistakes, and for comparison.

The following table gives the result of the analyses:—

No.	Date, 1855.	Weight in ozs. of 4 cent loaf.	Per centage of Dry bread.	Per centage of Ash.	Remarks.
1	January 6.	10·4	64·5	1·29	Pure bread.
2	" 27,	9·78	64·25	1·54	Salæratus—magnesia.
3	" 29,	12·65	61·8	0·89	Salæratus magnesia.
4	" 12.	10·12	56·69	0·79	Principally the crumb.
Id.	" 15,	9·87	62·8	1·11	No. 4 was the bread used for the preliminary experiments. It was perfectly pure with the exception of some magnesia, which I am not certain, from its quantity, whether it was purposely added.
Id.	" 22,	9·9	63·5	1·28	
Id.	" 24,	9·4	63·05	1·05	
Id.	" 25.	9·9	63·2	1·29	
Id.	" 30.	9·98	63·0	1·13	
Id.	February 1	9·44	63·4	1·22	
Id.	March 5	9·78 }	61·9	1·25	
Id.	" 5.	10·[illegible] }			
5	January 19	11·25	64·95	1·19	} Alum found in this bread in two samples.
Id.	" 31,	10·06	64·05	1·37	
6	February 2.	8·6	59·5	0·89	Copper detected.
7	" 3	8·0	63 1	1·42	Salæratus—magnesia.
8	" 5,	10·47	63·3	1·29	This was the finest bread of the lot and perfectly pure.
9	" 6	10·91	65·5	1·02	Much magnesia.
10	" 7.	10·4	61·8	1·26	Salæratus—magnesia.
11	" 8,	11·34	62·0	1·36	Salæratus.
12	" 9,	10·35	63·8	·08	Salæratus.
13	" 10.	9·8	63·9	1·33	Salæratus.
14	" 12,	9·49	61·1	1·36	Magnesia.
15	" 13.	11·32	64·2	1·39	Salæratus—magnesia.
16	" 14	10·49	63·9	0·75	Salæratus—magnesia.
17	" 15,	10,94	61·5	1·26	Alum and salæratus.
18	" 16,	10·64	63·95	0·97	Salæratus.
19	" 17.	11·1	62·5	1·21	A little salæratus.
20	" 19	8·69	64·45	1·13	Salæratus.
21	" 20,	10·49	62·05	0·89	Salæratus.
22	" 21,	9·05	65·9	1·19	Salæratus.
23	" 22,	12·43	63·0	1·28	Salæratus.
24	" 23,	9·72	65·1	0·76	Salæratus, also magnesia.

It will be seen, that *alum* was detected in Nos. 5 and 17, and *copper* in No. 6.

The following table of the price of flour per barrel, is compiled from the Philadelphia wholesale market price current of the Ledger, for the time during the examination of the bread, and will enable a calculation to be made of the profits of the bakers.

Date, 1855.	Mixed.	Standard and good straight brands.	Selected.	Extra and fancy family brands.
January 15,	. .	\$9·25	\$ 9·37	\$ 9·50 a \$10·50
" 22,	.	9· a \$9·25	. . .	9·50 a 9·62
" 29,	\$8·75	8·87½	9·00	10·
February 5,	8·75	8·87½	9·00	9·25 a 10·25
" 12,	. .	8·87½ a 9	. . .	9·50 a 10·37½
" 19,	.	9· a 9·25	. . . .	9·50 a 10·25
" 26,	. .	8·75 a 9·	. . .	8·12½ a 10·25
March 5,	.	8·75 a 8·87½	. . . .	9·25 a 10·00

The barrel should contain, I believe, 196 lbs. of flour. According to Dumas, 100 of flour will yield 130 of bread, and assuming this to be the yield in our city, (which is probably too low a proportion, since the French bread contains more crust relatively to the crumb than ours,) 196 lbs. of flour will yield 255 lbs., or 4080 ounces of bread. Now the mean weight of the four cent loaves of the bakery, No. 4, calculated from the table, is 9·83 ozs., and that of No. 5., 10·65. If these means be used in calculating the mean weight of the bread from all of the bakeries

in the table, it will give as a mean weight of 10·3 ounces for the four cent loaf, furnished by our bakers. When the barrel, therefore, costs $9·00, the cost of the *flour* in a loaf of 10·3 ozs. is 2·27 cents, and when the barrel is at $10·00, it is 2·52 cents.

Assuming 10 ounces for the weight which the four cent loaf ought to contain, the flour in it will cost according as the flour is $9 or $10 2·20 and 2·45 cents. It will be seen from the table, that there is a variation in some of the bakeries from the standard, amounting in some instances, to $\frac{1}{5}$th the weight of the loaf.*

The fourth column in the table, indicates the per centage of dry bread in the loaf. What is lost in the drying, is water, which diminishes from the nutritive power of the bread for given weights, consequently, other things being equal, the larger the amount of dry substance yielded by the four cent loaf, the cheaper it is. The mean per centage of dry bread from all the loaves examined of bakery No. 4, excluding the first specimen, which was principally from the crumb, is 62·98, and that of No. 5 is 64·5; using these means in calculating the mean of the bread from all the bakeries, we obtain the number 63·3. The numbers represent very accurately, the per centage of dry matter in the whole loaf of bread, for it was nearly all used in the experiments. According to Dumas' examination, the French bread contains 66 per cent. of dry substance in the whole loaf, and the crumb only 44—; our bread contains not more than 63·3, which arises from the fact that the proportion of crust to crumb is greater in the former, which is, consequently, for the same weights, cheaper. Reference to the table, will show the cheapest bread in this respect.

With regard to the ash, No. 4 gives a mean per centage (the first specimen being excluded for reasons mentioned above) of 1·19, and No. 5 gives mean 1·28. The maximum per centage of ashes in perfectly pure bread, treated as in the foregoing experiments, is about 1·25. Nos. 1 and 8, designated pure bread, were perfectly free from any addition to the flour beyond salt, water, and yeast; the per centage of ash in each of these cases, is 1·29. No. 8 was the finest bread I have ever seen. Almost all of the remaining bread, with the exception of Nos. 5, 6, 17, and perhaps 9, were just as wholesome as these, the additions of salæratus and magnesia not being such as to deteriorate the bread.

It will be perceived how frequent is the use of salæratus or a similar substance among the bakers. If it is not used in too great excess the bread obtained is equally good, and it is economical in saving a waste of the flour for furnishing the gases and liquids necessary to the rising of the bread.

I have, also, in connexion with these researches, examined a baking powder, which is very much puffed in the papers, and is said to be superior to cream of tartar, soda, salæratus, &c. It is simply a mixture of these substances, with a certain amount of flour; the bitartrate of potassa and carbonate of soda or potassa, are in the proper proportions, and a particular examination for alum, vitriol, and magnesia showed the absence of these substances. I believe it to be a good article, and have heard it well spoken of in families where it is used.

* A law exists compelling bakers to sell by weight; why is it not enforced?

For the Journal of the Franklin Institute.

Propulsion by Screws with the Axis above the Water.

We have observed in the *New York Nautical Magazine*, accounts of steam vessels on the lakes propelled by screws of large diameter partially submerged. In some instances the screw has been placed astern, as is usual in submerged screws—in others, at the sides of the vessel, the shafts being parallel to the keel.

Of the kind first mentioned may be instanced the *Buffalo*, *International*, and *Oriental*, of which we quote the particulars from the *Magazine* referred to:—

INTERNATIONAL.

Hull.—Tonnage 473. Draft, loaded, 8 feet.

Engine.—Diameter of cylinder, 33 inches; stroke of piston, 4 feet. Revolutions, 46 per minute.—Non-condensing, and vertical direct acting.

Screw.—Diameter, 17 feet. Pitch, 23 feet. Weight of cast iron centre, 9500. Weight of six wrought iron blades, 4800.—Total, 14,300.

Boiler.—One, tubular with drop return flued. Steam pressure, 75 pounds per square inch.

BUFFALO.

Hull.—Tonnage, 689. Draft, loaded, 10 feet.

Engine.—Diameter of cylinder, 32 inches. Stroke of piston, 4 feet. Revolutions, 42 per minute. Non-condensing, and vertical direct acting.

Screw.—Diameter, 15 feet. Pitch, 23 feet. Weight of cast iron centre, 9000 pounds; of six blades, 3600.—Total, 12,600.

Boiler.—One tubular, up return.

ORIENTAL.

Hull.—217 feet long on load line; 33 feet 8 inches beam; 14 feet 6 inches deep from base line to plank sheer. Load line, 10 feet above base line; of keel, helm, ditto, 1 foot, giving 11 feet load draft. Midship section at that draft, 308 square feet. Displacement, 1330 tons.

Engine.—One vertical square or crosshead engine; non-condensing. Diameter of cylinder, 36 inches. Stroke, 4 feet 8 inches Revolutions, 42 per minute.

Screw.—Diameter 18 feet; immersed 6 feet 6 inches. Pitch, 23 feet; six bladed. Length 26 inches. Of hub, 30 inches.

Boiler.—One drop flue and tubular. Length, 21½ feet. Shell, 10 feet diameter—with 12 large flues above and 186 tubes below, each 3½ inches "diameter." Grate surface, 54 square feet. Fire and flue surface, 2651 square feet. Consumption of coal, ¾ ton per hour (bituminous.) Average steam, 50 to 55 pounds, cut-off at ½ stroke.

Average speed, 9 miles per hour.

The idea is in that *Magazine* credited to Mr. H. O. Perry, of the Shepherd Iron Works, Buffalo, who, in 1850, designed the machinery for the first named. A description of a similar device may be found in *Bourne's Screw Propeller*, page 17, patented in 1825 by Jacob Perkins of London. The other plan, of side propellers, is claimed to have been introduced by Captain H. Whittaker, of Buffalo, in the steamer *Baltic*. We believe, however, that the first machinery of the *Iron Witch*, designed by Captain Ericsson, some five or six years ago, and tried in New York, was based on the same idea, for which a patent had issued July 26, 1838, to F. E. Fraisinet, of Westminster, and is described in *Bourne's Screw Propeller*, p. 26. The question of originality, however, need not be discussed at present. Our object is simply to call attention to these

applications of power in the propulsion of vessels, which are, practically, novelties. Whether they can ever be introduced in the Eastern navigable rivers must depend on the speed which may be attained hereafter. For marine purposes, we should be disposed to doubt their applicability, and for inland freighting boats, which have, in many cases, to pass through canals, the side screws would be out of the question. It is possible that the large stern screws might be applied to canal boats, if made of small pitch, so that the water would not be too much disturbed laterally. As yet, the vessels driven by the new screw, have not attained any greater speed than the average of propellers now in use, nor are the data of sufficient accuracy to warrant us in stating that much reduction in slip is effected. The slip in propeller steamers need not exceed 15 to 18 per cent. in average sea weather, when the pitch does not exceed $1\frac{1}{2}$ times its diameter; a proportion which may readily be maintained for any speed (within the ordinary limits) by gearing the propeller.

We hope, however, to hear further accounts from the lake engineers of their propellers, with accurate data on which to base a comparison.

M.

For the Journal of the Franklin Institute.

Performance of the Steamship North Carolina.

The loss of this ship off Holyhead, in consequence of having been run into by the Barque *Robert*, has been reported in the daily journals, but her performance ought to be recorded in order that, taken in connexion with the dimensions of her hull and machinery, (already given in this Journal Vol. XXVIII, Third Series, p. 411,) it may add to our experience in steam navigation. The vessel was originally built for the coasting trade, and specially modelled and designed for light draft of water. She had enormous carrying capacity, was of great breadth compared to her length, and intended as a freighting steamer exclusively.

After two trips to Wilmington, N. C., in which she performed well, it was determined to send her to Liverpool for sale or a charter. She was accordingly fully decked over between her poop and forecastle, and was despatched, very deeply loaded, (to 14 feet draft) from Philadelphia early in February. It was found, in going down the river, that she steered badly, but this was attributed to improper trim, inasmuch as she had previously steered remarkably well; accordingly she proceeded to sea, encountered extremely severe weather for several days, in which she was found completely unmanageable under sail, and was therefore propelled exclusively by her machinery. At length, when five days out and off Halifax, the bad weather continuing, and having been strained about her upper works, it was deemed advisable to put back, still under her machinery only, when, within 100 miles of the Delaware Breakwater, two blades of her propeller broke off, and she came in with the remaining one. Arrived in Philadelphia, she was taken on the dock, additional keel and a fore foot put on, her rudder enlarged, her upper works refitted, and the whole hull recaulked, it being found that her hull was as strong as when built; a new propeller was put on, (differing from

the former in being but 15 feet pitch instead of $16\frac{1}{2}$ feet,) and she again departed for her destination, leaving the Breakwater at 1 P. M., March 23d, loaded to $13\frac{1}{2}$ feet aft, $12\frac{1}{2}$ feet forward. On the passage she encountered some severe weather, but pursued her course without interruption till within six hours run from Holyhead, at 3 A. M., April 8, when run into as before mentioned, just abaft the fore chains; she sunk in seven minutes, giving the crew barely time to save themselves. Had her voyage been completed it would have been made, allowing for difference of longitude, in 15 days 9 hours from the Breakwater, which is 3200 miles run, giving a mean speed of $8\frac{1}{2}$ knots an hour. At her draft, before leaving port, her displacement was 1195 tons. The consumption of coal averaged 12 tons a day or 1120 pounds an hour. Her engine averaged 26 revolutions, or $69\frac{1}{3}$ of the propeller per minute, giving $17\frac{1}{4}$ per cent. slip. Steam averaged 23 pounds, cutting off at half stroke; vacuum $26\frac{1}{2}$ inches.

The boilers made steam as freely on the last day as on the first, and with any head wind (to improve the draft) furnished more than the engine could use. The advantages to be derived from large boiler surface, can scarcely be overrated. To this, principally, must be attributed the economy in coal of the *North Carolina*, which may be stated thus: 1195 tons displacement, propelled at the rate of $8\frac{1}{2}$ knots an hour, (in an average of all weathers,) one knot by the consumption of $\frac{1120}{8.5}=132$ pounds of coal. It should not be forgotten, that the true index of capability in steamships is to be found in the number of tons displacement, driven at a given speed over a given space, by the consumption of one pound of coal; and, it appears, by certain recent articles in the English journals, that this practical question is attracting the attention of steam engineers on the other side of the Atlantic.

The great improvements in Cornish engines were brought about by comparison of the "duty" performed; and a similar comparison of ocean steamers would tend to wholesome competition on the part of both ship builders and engineers. M.

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*On Steam Boiler Explosions and the Explosive Force of Highly Heated Water.** By John Sewel, Assoc. Inst. C. E., Great Western Railway, London.†

(Continued from page 343.)

3. The explosion of the "Goliah," locomotive boiler, when running on the South Wales Railway, in 1850, with nearly similar results to that of the "Irk." The inner copper fire-box was forced down; the engine broken from the tender, was raised in the air, turned end over, and carried to some distance. The engine had descended one incline, and was ascending another, when the explosion occurred. The descent would be effected with little or no steam, but which would be turned freely on to effect the ascent, causing an agitation in the boiler, and a rupture

* From the London Mining Journal, November, 1854.

† Read at the British Association Meeting, Liverpool, September, 1854.

immediately below the regulator opening took place at the unsupported angle of the copper fire-box, or the weakest part in the vicinity of the disturbed steam atmosphere.

Here, also, the running engine exhibits precisely the same feature as the standing engine did—local disturbance, local fracture, and a local concentration of explosive force overcoming the momentum of a train in motion, so far as to break away the engine, and to turn it end over.

4. The explosion of No. 137 locomotive boiler, in 1850, at Wolverton, is an instance differing from the preceding ones, by having the regulator source of agitation about the centre of the tubular part of the boiler, and not over the fire-box. The driver had turned on the steam to start the engine when the explosion took place; and the tubular part of the boiler was laid open along the underside, and torn away from the fire and smoke-boxes, which both remained but little injured. On the top side the regulator dome was blown off, and projected to a considerable distance: the longitudinal stay rods were bent upwards, or pulled from their end fastenings; the tubes were bent downwards, and one of the wheels of the engine was forced off.

Here, again, is the local disturbance, the local rupture, and explosive force, in proportion to the greater body of water in that locality than is in the locality of the fire-box. The dome being carried away removed the local abutment, and the extensive opening below gave the explosion less of the usual projectile character, and more of the rock blast nature, than when the chief body of water has to make its way to the fracture near one end of the boiler, which, gun-like, directs the course of projection in an opposite line.

5. The Midland locomotive boiler, which had been at work six years, burst in 1850, under the most ordinary circumstances, with the fire-door open, and with a pressure of only 56 lbs. per square inch on the boiler. The fire-box top was forced down immediately after the driver had been trying the gauge glass cocks, and is an instance of an explosion under circumstances which had been often previously withstood.

6. The York and North Midland boiler, which burst in 1850, when running, having the top of the copper fire-box forced down, and the engine projected about 15 yards. This boiler had also worked six years, and had doubtless often sustained the pressure which at last it failed to do.

7. The York, Newcastle, and Berwick boiler, which burst, when working, in 1850, exhibits the usual projectile force when the inner fire-box top gives way, with the addition, in this instance, of the fire-box end all blown off, followed by the smoke-door box also blown off. It was considered by Captain Wynne, that the top of the copper fire-box had been hot, from want of water, after having it examined by experienced mechanics. Here, again, is the local defect, local rupture, and exhibition of explosive force on three different points, apparently in succession.

8. The explosion of an old stationary boiler, at Wapping, is an instance of the peculiar hissing of incipient fracture being heard in time to let the hearer escape before the destructive explosion which followed took place. The engine had been started, then stopped, when the ex-

plosion took place, clearly showing the care that should be exercised in avoiding by all possible means any agitation, especially in an old boiler, where the limit between danger and safety is very little.

9. The explosion of the locomotive boiler in Longside shed, in 1853, as ably investigated by Mr. Fairbairn. The boiler was an old one, and had run 104,723 miles. The usual pressure was 80 lbs., and the steam was observed blowing off at that pressure, previous to the driver taking charge of it, when, it was said, the blowing off was stopped. It is a frequent practice to momentarily stop a safety valve blowing off, that instructions may be heard, or orders given, and this may have led to the observed stoppage. An explosion ensued, immediately under the safety valve: the outer plate of one side of the fire-box was blown off, and the inner fire-box bulged inwards by the reaction of the force, similarly to the brick-work at Hunt's Bank, and showing a similar localization of concentrated force.

In this instance also, the local agitation, by stopping the safety valve, the local rupture, and the local abutment of the acting force, are as prominent as in the other examples which have been referred to, and all compatible with a moderate pressure acting on a local defect.

Extraordinary pressure, caused by tampering with the safety valve, was one of the causes assigned for this explosion, and an investigation was ordered, under the control of Mr. Fairbairn. This was done by testing another boiler, of the same age and class, by hydraulic pressure, when leakage began at about 110 lbs. pressure, and increased as the pressure increased. It was next ascertained that steam would rise from 80 lbs. to 108 lbs. pressure per square inch in four minutes, which is valuable, as showing the danger of stopping a safety valve blowing off, with the best of boilers.

A flat sided box was made, to represent the burst fire-box, and it required a pressure of 1595 lbs. per square inch to bulge the side about one-third of an inch, which gives an idea of the explosive force which bulges brick-work and strong copper plates, or carries off well riveted domes, like a bomb shell from a mortar.

Subsequent experiments showed that it required a force of 8·1 tons to draw out a $\frac{3}{4}$-inch iron stay, screwed into a copper plate $\frac{3}{8}$-inch thick; 7·2 tons to draw out a $\frac{3}{4}$-inch copper stay, screwed into a $\frac{3}{8}$-inch copper plate; 10·7 tons to draw out a $\frac{3}{4}$-inch iron stay, screwed and riveted into a $\frac{3}{8}$-inch copper plate; and 12·5 tons to draw out a $\frac{3}{8}$-inch iron stay, screwed and riveted into a $\frac{3}{8}$-inch iron plate.

These results correspond with the known relative strength of copper and iron, when cold; but the Franklin experimenters showed the rapid loss of strength in copper as its temperature increases. At the temperature of 328° Fahr., or 80 lbs. high pressure steam (95 lbs. gross pressure), copper had lost about 12 per. cent of its strength, when cold; while iron has rather increased its tenacity, according to the same authorities.

Mr. Fairbairn's experiments are highly valuable, as indicating the strength of a well constructed locomotive boiler, but they only bear indirectly on local defects, whether original or produced by time, by vibration, by neglect, or by any other cause, or by a combination of causes. Thus, it is quite common to find many of the fire-box stays broken, and

a part of the transverse partition of the same fire-box less than $\frac{1}{8}$-inch thick, yet safely confining water under a pressure of 120 lbs. per. square inch.

There would be no comparison between the strength of the broken stays and a strip of the worn copper, yet the stays break, and the thin copper stands, exhibiting two striking practical facts for the consideration of scientific authorities.

The copper stays are found to break close to the edge of the iron plates, and appear to be liable to the same deterioration from arrested vibrations at these points, as has been ascribed to railway axles.

As copper has little more than half the tenacity of the best iron, it follows that copper stays, subjected to such concussive vibrations, would rapidly lose their cohesive tenacity, which, added to the loss of strength by the temperature, may account for their frequent failure under ordinary circumstances.

Iron stays give much greater strength, but if subjected to injurious vibrations at the edges of the plates, their ultimate fracture would be a question of time, as it is with axles. The frequent occurrence of very thin parts in the transverse copper partitions of fire-boxes, and the absence of any known explosion at such parts, is a singular practical fact in steam boiler experience.

Although the fracture of the stays is frequent at the sides and front end of the fire-box, yet none of the stays of the flat sided transverse partitions have been found broken, whilst the centre of that partition itself has been worn to less than $\frac{1}{8}$-inch thick. A specimen, cut from one of these partitions, accompanies this paper, and shows the extremely small section of copper which confined water pressed to 110 lbs. above the atmosphere in a locomotive boiler, in daily work.

There is no comparison between the sectional strength of the outside copper stays, which frequently break, and that of the strip of copper from a part where no fracture has been known to occur.

The position is one subject only to the vibration of contraction and expansion of the inner fire-box, and is also remote from the usual point of steam agitation, for it scarcely admits of a doubt that on the roof of the fire-box such a thickness of copper would soon give way. The external shell of the fire-box is subject to the jars and vibrations of the frame from traction and buffing, or compression, besides those due to it as a boiler, which lead to the fracture of the stays, and other local injuries.

It is, therefore, quite possible that experiments made on two boilers, of the same age and class, might give very different results, depending upon the circumstances of each of them. However, the fellow boiler, tried by Mr. Fairbairn, began to leak at 110 lbs. pressure, and the leakage increased as the pressure was increased. A yielding of that boiler to the extent of $\frac{1}{20000}$th part of the volume of water would give relief, but the least yielding to steam pressure calls into operation the expansive force of the water and steam, which follows up the elongation of any part once begun, until fracture ensues, when strong iron plates and riveted joints are torn and twisted like the sails and rigging of a ship in a hurricane, or trees caught in a whirlwind, for the steam and atmospheric currents are alike suddenly developed, alike destructive, and alike short lived.

10. The Rochdale boiler explosion, July, 1854. This is an instance of an old boiler, extra pressure, local defect over the fire, bad management, and agitation, causing a most disastrous and fatal explosion. The boiler had been at work for eight years, was made for pressure of 30 lbs., but urged by firing to about double that pressure, to do much more work than it was originally designed for. It was an egg-ended cylindrical boiler, about 14-horse power, and had begun to leak over the fire, but had been repaired to some extent.

Hard firing not unfrequently injures the boiler plates most exposed to it, so that the leakage may have occurred from such injury; and the time it took to stop the leak, after the repairs, showed that it had been of a partial nature, or a patch over the old plate—a dangerous mode of repair.

On the day of the explosion the boiler had been very irregularly worked; the engine started, stopped, and started again, causing renewed agitation, if not greater pressure, when the explosion occurred, with gunpowder-like destruction to all persons and property near it. The boiler appeared to have been first raised from its seat, and then burst into fragments, and projected in various directions. The safety-valve piece, about 50 lbs., was projected farthest, or about 300 yards, as if it had been the first point of abutment, opposite the first fracture which raised the boiler; the whole shell of the boiler appears next to have been burst into fragments, and projected east, west, and north, by the explosion of the water into steam, with gunpowder-like rapidity and force.

Here is also the local defect, the agitation, the extra pressure, the local first fracture, indicated by the raising of the boiler, and the projected safety-valve seat, and an exhibition of explosive force so startling, that the *Times* of July 17th, compares it to thunder, and to bomb-shells exploding; whilst, in his report to the jury, Mr. Fairbairn compares it to "the springing of a mine, which resulted in tearing the boiler into strips, and the destruction of every thing with which it came in contact."

Ordinary fractures of one part of a boiler, guide and restrain, to a certain extent, the expansion of the hot water, but when the boiler shell is laid open, as at Wolverton, in 1850, or burst into pieces, as at Rochdale, in 1854, there is no check to the instantaneous expansion of water into steam of atmospheric pressure and volume. In such cases the projectile abutment is the common centre of resistance of the expanding water and steam, similar to gunpowder, when similarly exploded. Suppose the Rochdale boiler to have had a capacity of 300 cubic feet, of which 200 was filled with water and 100 with steam, of 60 lbs., high pressure, and a temperature of 311° Fahr., the expansion would be from 300 cubic feet to 378,200 cubic feet, all but instantaneously effected.

The boiler had been pressed far above what was considered safe for some time, and thus being strained ordinarily to the full elastic limits, it burst into eight or ten pieces, tearing the boiler plates into strips, and destroying all around, precisely the same as if gunpowder, with an equal amount of expansive force, had been exploded.

It was considered that the pressure required to tear the boiler to pieces, as it was done, would be about 300 lbs. per square inch, but a very much greater force than this was called into action by the first beginning to rupture; and if it was considered dangerous to work the boiler to 60 lbs.,

it is not likely that it ever reached any such pressure as 300 lbs. per square inch, previous to the fracture.

A careful perusal of the graphic report of this explosion in the *Times* of the 17th July last, will satisfy almost any one of the explosive action of hot water under such circumstances, and may be regarded as direct proof of the views advocated in this paper, little expected, when it was written in 1851, for a treatise on locomotives, not published.

11. The Victoria boiler explosion, near Preston, 1854. The recent explosion of the *Victoria* steamboat, on the Ribble, was traced to an original defect in the design and construction of the flue, after it had passed the ordinary inspection of a Government agent. Since the external appearance rarely indicates the local defect of workmanship, or plates, or design, some more satisfactory test becomes desirable than an eye inspection. Hydraulic pressure gives this test, and is easily applied. Thus, let a boiler, when made, be carefully measured by callippers externally, and the internal flues also. Then let it be pressed by water to at least 80 per cent. more than the pressure it is made to confine, and again measured by callippers.

The distortion, if any, would show the relative strength of the different parts, and thus point out local defects by altered form, or by leakage, or by both. A certificate of such test, and of the safe limit of pressure to be given, and a copy of it kept, as evidence against recklessness, by increased pressure, whenever it should be required.

Many other examples of explosions show how small is the limit between danger and safety, and the necessity of employing only careful, experienced men, to attend boilers: for the larger the boiler, the greater is the explosive magazine it contains, and the more dangerous any unusual agitation of its contents, caused by inattention, carelessness, or neglect.

These examples, it is hoped, will induce practical men to carefully note and report the particulars of every explosion which comes under their especial notice, that the important question of boiler explosions may be placed on a sounder basis than it has hitherto had. In all cases of judicial inquiry, this course should be adopted, and ordinary causes fully exhausted, before extraordinary ones are allowed to influence experienced men, or guide the decision of courts of law.

From what has been advanced, it is concluded:—

1. That many boiler explosions may be traced to causes only slightly varied from those in daily operation. 2. That the real strength of a boiler is far below its nominal strength, and frequently very little above the quiescent pressure of the steam in it. 3. That the explosive force of the water and steam has the gunpowder-like power of expansion, developed after their release from confinement.

Appendix.—*Accompanying Pieces of Copper.*—The three thin strips of copper, about 17 inches long altogether, were cut transversely out of a locomotive fire-box partition, originally $\frac{7}{16}$ inch thick. At one end the strip is No. 14 wire gauge thick, at the other end No. 11, and part of it is only 17 wire gauge thick. In area, about 24 inches by 3 inches, or 72 square inches was nearly alike thin, yet safely confined water under a pressure of 110 lbs. per. square inch, in daily working.

The strips of copper now sent are no solitary instance of the kind, but an example of the wear to which that class of transverse partitions appear to be subject, as thinner pieces have been taken out than this one on several occasions.

The curved top of the partition is about 8 inches above the curved line of the lowest tubes, and the wear seems to follow the same transverse line about 4 in. below the top, and mostly between the two upper rows of $\frac{7}{8}$-ths inch copper stays, 4 inches apart. The thinning is, however, gradual, and extends transversely from 18 to 30 inches, and vertically from 6 to 10 inches, so that it chiefly occurs above the ordinary level of the fire, and on both sides of the partition. The samples are from the side next the tubes, where the coke could not be thrown against, and usually this side lasts double the time of the side next the fire-door. In this instance the fire-door sides had been worn down, a piece cut out, and the new piece worn again to No. 15 wire gauge thick, when both back and front had to be cut out. Out of a number of cases, no instance has been seen of anything like a rupture, or even bulging, whilst on the outside shell, broken stays and bulged sides are not unfrequent.

Further Observations on associated cases, in Electric Induction, of Current and Static Effects. By Professor Faraday, D.C.L., F.R.S., &c.*

Melloni, whose loss science must deeply feel, was engaged in the latter part of his life in investigations relating to static electricity, especially concerning induction, conduction, &c. He desired, in reference to these and the results I had published respecting the charge of, and conduction by, subterraneous and subaqueous insulated wires,† to know whether there was any difference in the *time* of transmission through such wires, of currents having greater or less intensity, *i. e.* of currents from batteries of different numbers of plates. I applied to Mr. Latimer Clark on the subject; and he with the same earnestness as on the former occasion, sought and seized the opportunity of making experiments of the like kind, and gave me the results, which I sent to Melloni. The latter published them with some observations in an Italian Journal (whose title is not on the paper which he sent to me,) and soon after he was suddenly removed from us by death. As Mr. Clark's results are not yet known in this country, I have thought that a brief account of them would be valuable. His process records, by the printing telegraph of Bain, the results obtained with 768 miles of copper wire covered with gutta percha, and laid in the ground in four lines between London and Manchester, so connected that the beginning and the end of the whole length was in London. The following are his words, dated May 31, 1854:—

"I have tried a few experiments on the relative velocities of currents of different intensities, and I enclose you some strips of paper showing the results. I was unable to equalize the deflexions of a galvanometer by currents of intensity with small plates as compared with currents from

* From the Lond., Edin. and Dub. Philos. Mag. March, 1855.
† Royal Institution Proceedings, i. 345; or Phil. Mag. 1854, vii. p. 197.

a few large plates, for no size of plate would make up for the deficiency in intensity. I allude to the form of experiment suggested by Melloni;—but I believe they will be of interest to him.

"The experiments were made through 768 miles of gutta percha wire, viz: from London to Manchester and back again twice, with our ordinary sulphate of copper batteries, plates 3 inches square, and with intensities varying from 31 cells to sixteen times 31 cells, or 500 cells.

"In the accompanying strips the upper line indicates the time during which the current was sent, being made by a local arrangement.

"The second line (of dots) indicates *time by seconds*, being made by a pendulum vibrating seconds, and striking a light spring at the centre of its arc of vibration.

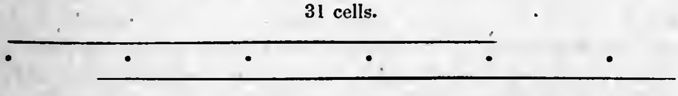
"The third line indicates the time at which the current appeared at (what we may call) the distant end of the line, 768 miles off.

"The fourth line merely shows the residual discharge from the near end of the wire, which was allowed to communicate with the earth as soon as the batteries were disconnected; this has no reference to the subject of our inquiries.

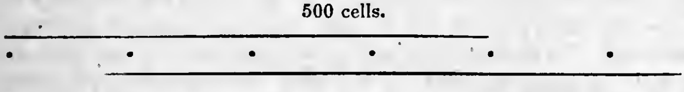
"It will be seen by the *third line*, that about two-thirds of a second elapsed in every case before the current became apparent at the distance of 768 miles, indicating a velocity of about 1000 miles a second; but the most interesting part appears to be, that this velocity is *sensibly uniform for all intensities* from 31 cells to 500."

Melloni has then given a copy of the records made when 31 pair and 500 pair of plates were employed; unfortunately the copy is inaccurate, since it makes the fourth line commence as to time at the termination of the third, whereas it ought to correspond with the termination of the first; also the third line on each does not thin off as those upon the record do. The following is a copy from other slips obtained at the same time from the Bain's printing apparatus. Experiments with 62, 125, and 250 cells, gave like results with those of 31 and 500 cells.

31 cells.



500 cells.



After certain observations, which are mainly upon the manner of the experiments, and the way in which practical difficulties were avoided, Melloni says, " it appears, then, that when the electric current possesses sufficient force to overcome the sum of the resistance offered by a given conductor, whatever its length may be, an augmentation of its intensity ten or twenty fold does not alter the velocity of its propagation. This fact is in open contradiction with the general meaning attributed to the denominations of *quantity* and *intensity;* since the first compares the mass of electricity to that of a fluid, and the second represents its elasticity or

tendency to motion. The equal velocity of currents of various tension offers, on the contrary, a fine argument in favor of the opinion of those who suppose the electric current to be analogous to the vibrations of air under the action of sonorous bodies. As sounds, higher or lower in pitch, traverse in air the same space in the same time, whatever be the length or the intensity of the aërial wave formed by the vibration of the sonorous body; so the vibrations, more or less rapid or more or less vigorous, of the electric fluid excited by the action of batteries of a greater or smaller number of plates, are propagated in conductors with the same velocity. Every one will see how the hypothesis imagined by us to give a reason for natural phenomena, will serve to suggest certain experimental investigations, the results of which will test their validity or insufficiency."

Melloni then says, that he shall shortly have occasion to publish facts which clearly demonstrate the errors of certain conclusions admitted up to the present time respecting electro-static induction; and I am aware, from written communications with him, that he considered the results arrived at by Coulomb, Poisson, and others since their time, as not accordant with the truth of nature.* In the mean time he died, and whether his researches are sufficiently perfected for publication or not, I do not know.

The uniformity in the time and appearance of currents of different intensities at the further end of the same wire in the same inductive state, is a very beautiful result. It might at first be supposed to be in opposition to the views I set forth some years ago on induction and conduction, and the statements more recently made with regard to *time*. That, however, does not appear to me to be the case, as a few further observations on Mr. Clark's recent experiments will perhaps show. When the smaller battery is used, much less electricity passes into the wire in a given time, than when the larger one is employed. Suppose that the batteries are so different that the quantities are as 1 to 10; then, though a pulse from each would take the same time for transmission through the wire, still it is evident that the wire would be a tenfold better conductor for the weak current than for the strong one; or in other words, that a wire having only one-tenth of the mass of that used for the greater current should be employed for the smaller one, if the resistance for *equal quantities* of electricity having different intensities is to be rendered equal.

My views connect the retardation of the transmitted current with the momentary induction set up laterally by the insulated and externally coated wire. The induction will be proportionate to the intensity, and therefore its especial effect on the time of retardation proportionately diminished with the less intense current,—a result of action which will aid in rendering the time of retardation of the two currents equal.

* He says, "I deceive myself much, or else the fundamental theorem of electrical induction, as we find it ordinarily announced, ought to be modified so as not to confound two effects completely distinct—the electric state during induction, and after the contact and separation of the inducing body. We know perfectly what occurs in the latter case, but not in the former," &c. Again, "In my last letter I raised doubts with regard to the consequences which have up to the present been deduced from the experiments serving as a base for the fundamental theorem of electro-static induction. These doubts have passed to a state of certitude in my mind, ... and behold me at this time thoroughly convinced that the enunciation of that theorem ought to be essentially modified." (July, 1854.)

The difference of *time* in the former experiments with air wires, and earth or water wires, very clearly depends upon the difference of lateral induction; the air wire presented a retardation scarcely sensible, the earth wire one amounting to nearly two seconds. If the insulating layer of gutta percha could be reduced from 0·1 to 0·01 of an inch in thickness, and mercury could be placed on the outside of that instead of water or earth, I do not doubt that the time would be still more increased. Yet there is every probability that in any one of these varying cases, electric currents of high and of low intensity would appear at the end of the same long wire after equal intervals of time.

Mr. Clark's results may be stated thus:—A given quantity of electricity at a high intensity, or a smaller quantity at a proportionally lower intensity, will appear at the further end of the same wire after the lapse of the same period of time. My statement assumed the discharge of the *same* quantity at *different* intensities through the *same wire*, and the quantities in the illustrative experiments were measured by a Leyden jar. In the consideration and further development of these results, it must be remembered that it is not the difference either in time, velocity, or transmission of a *continuous* current which constitutes the object in view, for that is the same both for an air wire and a subterraneous wire, but it is the difference in the *first appearance* only of the same current when wires under these different conditions are employed. After the first appearance both wires are alike in power unto the end of the current, and then a difference again appears which is complementary to the first.

There are many variations of these experiments which one would wish to make, if possible, and perhaps by degrees the possibility, or else equivalent experiments in other forms, may occur. If the wire employed were changed from a cylinder to a flat ribbon of equal weight, or to several small wires, all being equally coated with gutta percha and submerged, differences would probably arise in the time of delay with the same current; and I think that the ribbon, presenting more induction surface than the cylinder, would cause more delay; but probably any one of these, or of like varieties, would cause the *same* delay for currents of different intensities. Again, one can scarcely doubt that with different conducting substances, as iron and copper, the delay would vary, as is the case in the transmission of sound and light. That the delay for currents of high and low intensity should be the same for the same wire in any one of such cases may still be expected, but it would be very interesting to *know* what would be the fact.

The prosecution of these results and the principles concerned in them, through the various forms they may assume by such like variations of the conductors and also of the currents, offers, as Melloni has observed, most extensive and interesting inquiries: even the power of a current to induce a current in neighboring wires and conductors is involved in the inquiry, and also the phenomena and principles of magneto-electric induction.

Royal Institution, Feb. 7, 1855.

Rags and Paper. By J. B. SHARP, Esq.*

An Account of RAGS *Imported into the United Kingdom, Exported from the United Kingdom, and left for Home Consumption, from* 1801 *to* 1853*; stated in Five Decennial Periods, terminating respectively in* 1810, 1820, 1830, 1840, *and* 1850, *and in the Three Years,* 1851 *to* 1853.

Years.	Import.	Export.	Left for Home Consumption.
	Tons.	Tons.	Tons.
1801 to 1810 .	30,696	11	30,685
1811 " 1820 .	38,107	1,649	36,458
1821 " 1830 .	80,088	786	79,302
1831 " 1840 . .	95,203	2,138	93,065
1841 " 1850 .	74,463	2,950	71,513
1851 " 1853 .	27,997	4,762	23,235
Total Quantities imported, exported, and remaining for Home Consumption in 53 years, ...	346,554	12,296†	334,258
General Annual Average of import, export, and remaining for Home Consumption in 53 years,	6,539	232	6,307

An account of the Quantity of PAPER *made, and the Gross Amount of Duty paid thereon, in the Five Years.* 1830 *to* 1834, *preceding the Reduction of the Duty; and in the last Five Years,* 1849 *to* 1853.

Year.	Pounds made.	Gross Amount of Duty.	Year.	Pounds made.	Gross Amount of Duty.
		£			£
1830, .	68,378,566	747,114	1849, .	132,132,657	859,575
1831, .	66,974,186	728,862	1850, .	141,032,473	915,121
1832, .	69,804,443	763,104	1851, .	150,903,543	993,592
1833, .	73,644,997	804,513	1852, .	154,469,211	1,000,630
1834, .	76,138,466	833,822	1853, .	177,633,009	1,148,116
Total in five years, .	354,940,658	3,877,415	Total in five years, .	756,170,893	4,917,034
Average per annum,	70,988,131	775,483	Average per annum,	151,234,178	983,407

The total quantity of material of all kinds consumed in the manufacture of paper, ranges between 110,000 and 120,000 tons per annum, at the present rate of production; and the whole of our import of such material, as shown in a preceding table, only amounts to about 6 per cent. of the entire consumption.

*From the Journal of the Statistical Society of London, March, 1855.

† Of this quantity of 12,296 tons exported, the official accounts, from which these details are derived, show that 10,146 tons were British and Irish rags, and 2,150 tons were foreign rags re-exported.

Analysis of a Surface-soil from the Desert of Atacama. By F. Field.*

On the confines of the Desert of Atacama, a few miles to the east of the port of Caldeca, in the north of the Republic of Chile, the soil for many leagues around has a perfectly white appearance, exactly as though it had been covered by a recent fall of snow. On investigation, it appears to consist of a white crystalline matter, which extends to the depth of six or eight inches below the surface; and on digging one or two feet deeper, large quantities of water are discovered, highly impregnated with saline matter. If the white substance be carefully scraped away, leaving an apparently clean surface of sand exposed to the air, crystals gradually form, and in a few weeks the spot is as white as before. The following is the composition of the substance taken from many parts of the locality above mentioned, affording a pretty correct illustration of the surface-soil of this part of the desert of Atacama:

100 grms. gave:

Soda,	27·17
Sulphuric acid,	42·60
Chlorine,	9·63
Lime,	6·72
Magnesia,	4·75
Water,	12·30

with traces of oxide of iron, potash, and carbonic acid.

Deducting an equivalent of sodium for the formation of the chloride, the following numbers are obtained:

Sulphate of soda,	41·77
Sulphate of lime,	16·32
Sulphate of magnesia,	13·75
Chloride of sodium,	15·60
Water,	12·30
	99.74

with the traces of oxide of iron, and carbonates of lime and soda.

This substance is perfectly soluble in cold water, if added in sufficient quantities, and digested with it for a long time; dilute hydrochloric acid dissolves it readily, with scarcely perceptible effervescence. It is slightly alkaline to test-paper,—due, probably, to a trace of carbonate of soda. When dissolved in water at 100° F., and allowed to cool, it deposits large crystals of sulphate of soda. I have sent home a specimen of the soil, and also some crystals of sulphate of soda produced from it by simple solution and crystallization. One pound of the soil produces more than its own weight of crystallized sulphate of soda.

I am now engaged upon an investigation of the sub-soil, taken three feet below the surface of the desert.

On the Gold Fish of Franklin†.

In a note at the foot of page 250 of the 37th volume of the *Philosophical Magazine*, a question of interest both in a mechanical and electrical point

* From the Lond. Journ. of the Chemical Society, Jan. 1855.
† From the Lond., Edin. and Dub. Philos. Mag., March, 1855.

of view is suggested by the following statement of Prof. W. Thompson: —"*The phenomenon of a solid body,*" writes Mr. Thompson, "*hovering freely in the air, in stable equilibrium, without any external support, has never, I am convinced, been witnessed as the result of any electrical or magnetical experiment.*" An experiment described by Franklin, and redescribed by Prof. Srtsczek of Pesth,* without any knowledge of what Franklin had done previously, seems to furnish the precise fact alluded to by Prof. Thompson. If the knob of a charged Leyden jar be caused to approach a number of scraps of gold leaf, the consequent jumping of the leaves is well known. If a certain shape be imparted to the gold leaf, when the knob is approached the leaf is attracted and moves towards the knob; but, before it reaches the latter, it is arrested, and hovers in the air, like a fish in water. When the atmosphere is dry, the leaf can be preserved swimming for hours together "without any external support or constraint."

The following description of the experiment by Prof. Srtsczek is taken from Poggendorff's *Annalen*, Vol. lxxxviii, p. 493.

Let a small Leyden jar which can be held conveniently in the hand be charged with, say, positive, electricity. Let the knob be gradually brought near to several bits of gold leaf lying upon clean paper, from 6 to 12 lines in length, and from a line to a line and a half in width: they may be rectangular, lozenge-shaped, trapezium-shaped or triangular.

A jumping of the leaves immediately commences, but soon the remarkable fact will be witnessed that one or more of the scraps will suddenly halt in their movement, and remain freely floating in the air; sometimes rotating round the knob of the jar, and showing a tendency to rotate round their own axes.

The knob must reach several inches above the insulated rim of the jar, so that scraps which hover at a considerable distance may not be attracted by the rim. At the conductor of a machine, the swimming of the gold-leaf is also seen at a much greater distance (a foot for example,) but the experiment does not succeed so quickly. The leaves must be smooth, and of an elongated shape.

With the same strength of charge, portions of gold-leaf, equally long, but of different shapes, hover at different distances from the knob.

With the same charge, and scraps tolerably alike in shape, the long ones hover at greater distances than the short ones. This is most plainly seen when the experimenter succeeds in causing several scraps to swim at the same time.

When the charge diminishes in intensity, the leaves slowly approach the knob of the jar; when, however, by means of the knob of a second jar, electricity is communicated to the former, the leaves again recede. In this manner, when the air is dry, a scrap of gold-leaf can be kept swimming for hours.

In some cases the rotation first begins when the floating leaf comes near to the jar, and the rotation is accelerated as the leaf approaches.

With scraps of a suitable shape, the equilibrium is so stable that the upright jar may be suddenly pulled downwards, without altering the hovering condition of the scrap of gold-leaf.

* And, we believe, exhibited in a modified form by Professor Faraday in his public lectures.

From the side of the leaf most distant from the jar, electricity is given off of the same name as that wherewith the jar is charged; and it has the power of propagating itself to a considerable distance. When a gold-leaf electroscope is placed near the "fish," a permanent divergence is observed after the instrument has been removed.

When the swimming leaf is removed from the neighborhood of the knob, by suddenly withdrawing the jar, it is found that those pieces which swim at about an inch distance are in a neutral condition; while those which swim at a less distance are negative. Only such as, while swimming, come very near the knob of the jar, show sometimes positive electricity.

In a note to this paper, Prof. Poggendorff remarks:—"Although the more recent treatises on electricity do not mention the fact above described, still it is not new, the experiment having been made by Franklin, in 1749, on the conductor of an electric machine, (see *Experimental Observations on Electricity*, &c., London, 1769, p. 72). The free hovering of a piece of gold-leaf, in so stable a position, must always be regarded as a most remarkable fact, which is deserving of revival, particularly as very few appear to be acquainted with it."

In the following volume of the *Annalen*, p. 164, Prof. Riess makes the following remarks:—"A bit of gold-leaf, *differently* pointed at its ends, and with its blunter end towards the conductor of an electric machine, flies towards the latter, and remains floating at a distance from it, because the electric wind generated at the blunter end drives it back, while that generated at the sharper end and the electric attraction drive it towards the conductor. A point on the side of the strip of gold-leaf must cause an axial rotation. The same action may be observed with a sewing-needle which has its eye broken off. When it is suspended horizontally and the knob of a Leyden jar is carefully brought near it, at a certain distance from the knob the pointed end is strongly repelled, while the blunt end is attracted."

We may add to these remarks, that in some cases we have succeeded in causing a bit of gold-leaf to flutter so speedily as almost to obscure its shape, and give it the appearance of an insect busily plying its wings. When the hand is approached, the fluttering ceases, and the little swimmer floats tranquilly in the atmosphere. So strong is the electric wind proceeding from the floating scrap, that it can be distinctly felt, as a cold draft, at a distance of five or six inches.

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*New Jointing for Gas, Water, and Steam Pipes.**

Messrs. William Smith and Thomas Phillips, of Snow-hill, have patented a new model of constructing and connecting pipes or tubes for gas, water, or steam purposes, consisting of forming at the ends of each length of pipe or tube a narrow rim, with bevelled edges, so formed that when one length of pipe or tube is placed in connexion with another, the bevelled edges thus brought together, formed between them a ring or

*From the Lond. Builder, No. 637.

groove to receive suitable packing. The joints when packed are enclosed and held together by socket pieces, formed to act upon the rims for that purpose. These socket pieces are formed in halves, with flanches for screws to hold them together when applied to the junctions of the pipes. It is also proposed to form the end of the pipes at an angle to a line drawn through such pipes in the direction of their length, by which the continuance in a straight line, or a divergence therefrom in several lengths of pipe, is affected by the position of one pipe or tube next to be connected in relation to the preceding. The angular end of one piece will make up for the angularity of that preceding, in order to maintain a straight course; but by turning the pipe or tube partly round, a divergence from the straight line will be more or less obtained, whereby the use of curved or bent pipes may in a great measure be dispensed with.

For the Journal of the Franklin Institute.

Particulars of the Steamer Astoria.

Hull built by William H. Webb, New York. Machinery by Hogg & Delamater, New York. Intended service, San Francisco to Cilka.

Hull.—			
Length on deck from fore part of stem to after part of stern post, above the spar deck,		160 feet.	
Breadth of beam at midship section above the main wales,		25 "	
Depth of hold,		12 "	
Draft of water at load line,		8 "	6 inches.
Tonnage,	500.		
Area of immersed section at load draft,		127 sq. feet.	
Masts and rig,	Barque.		
Engines.—Vertical direct.—			
Diameter of cylinders,			26 inches.
Length of Stroke,		2 feet	2 "
Boiler.—One—Return flued.—			
Length of boiler,		22 feet.	
Breadth "		5 "	6 inches.
Height " exclusive of steam chimney,		9 "	6 "
Number of furnaces,	2.		
Length of grate bars,		6 feet	6 "
Number of flues,	10.		
Internal diameter of upper flues,		1 foot	7 "
Heating surface,		1200 sq. feet.	
Diameter of smoke pipe,		3 feet.	
Height "		24 "	
Description of coal,	Bituminous and anthracite.		
Draft,	Natural.		
Propellers.—			
Diameter of screw, (Griffith's,)		9 feet.	
Pitch of screw,		16 "	
Number of blades,	2.		

Remarks.—Floor timbers at throats, *molded* 12·5 ins.; *sided* 5 inches. Distance of frames apart *at centres* 30 inches. Propeller fitted to hoist out of water.

H.

For the Journal of the Franklin Institute.

Particulars of the Steam Boat Elm City.

New York.—Hull built by S. Sneden, New York. Machinery by Neptune Iron Works, New York. Intended service, New York to New Haven.

Hull.—		
Length on deck,		280 feet.
Breadth of beam at midship section—*molded*,		35 " 2 inches.
Depth of hold,		11 "
Draft of water at load line,		5 " 6 "
Tonnage,	1100.	
Area of immersed midship section,		175 sq. feet.
Masts and rig,	none.	
Engine—One—Vertical beam.—		
Diameter of cylinder,		65 inches.
Length of stroke,		12 feet.
Boilers—Two—Return flued.—		
Length of boilers,		32 feet 6 inches.
Breadth "		11 "
Height " exclusive of steam chimney,		10 " 3 inches.
Number of furnaces in each boiler,	2.	
Length of grate bars "		8 feet.
Number of upper flues "	5.	
Internal diameter of upper flues,		1 foot 5½ inches.
Heating surface,		3556 sq. feet.
Grate surface,		162 "
Diameter of smoke pipes,		4 feet 10 inches.
Height " "		32 "
Number of " "	2.	
Description of coal,	Anthracite.	
Draft,	Fan blast.	
Paddle Wheels.—		
Diameter,		34 feet 6 inches.
Length of blades,		9 "
Depth "		30 "
Number "	28.	

Remarks.—Floor timbers at throats, *molded* 16 ins.; *sided* 11 ins. Distance of frames apart *at centres* 24 ins. H.

Silicate of Soda as a means of fixing Aluminous and Iron Mordants: By Prof. Bolley.*

The use of silicate of soda in calico printing has the advantage of rendering the colors deeper than when the dung-bath alone is used. In reference to the action of this salt, it is worthy of remark that alkaline silicates exist in cow-dung, which according to Rogers contains 17·5 per cent. of solid substance ; 15 per cent. of this is ash, so that the fresh dung contains 2·6 per cent. of ash, and the ash contains 62·5 per cent. of silica. A large portion of this silica is in the insoluble condition, but the quantity of soluble silica is not inconsiderable. The soluble portion of the ash amounts to 38 per cent., and of this, 12 per cent. is silica, and 10 per cent. potash and soda.

There is therefore reason for regarding silicate of soda, as the efficient ingredient of cow-dung. C. Kœchlin found that the constituents of mor-

* From the Chem. Gaz. No. 295.

dants are met with in the dung-bath after being used, and that the alumina is in solution; whence it must be inferred that a part of the aluminous mordant is dissolved in the dung-bath. However, it still remains to be ascertained in what manner this is effected, what the solvent is, and why the alumina is not precipitated by the salts in the dung. But, on the other hand, it is known that aluminous salts, and even alkaline solutions of alumina and phosphate of alumina, are decomposed by silicate of soda, while insoluble silicate of alumina is formed. Considering all these circumstances together, there are grounds for the opinion that the mordant is converted by silicate of soda into an insoluble state, which is wholly unaffected by the dung-bath.—*Schweizerisches Gewerbeblatt*, May, 1854.

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*Beaumont's Hollow Cone Disk Pressure Gauge.**

A new modification of the aneroid gauge for ascertaining fluid pressures, is exhibited under two views in the annexed engravings. Fig. 1 is a face elevation of the gauge, showing the internal pressure chamber, and the means of actuating the index hand. Fig. 2 is a section of the pressure chamber detached. The flat shallow case, A, similar to that

Fig. 1.

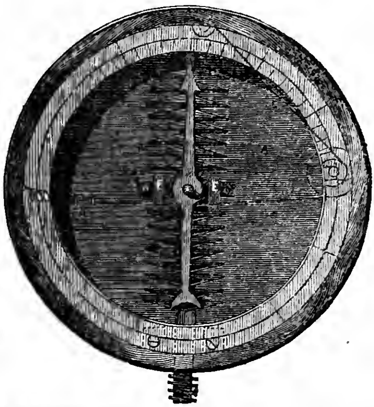
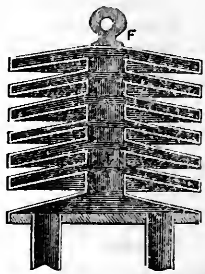


Fig. 2.



used by Mr. Sidney Smith in his ingenious elastic diaphragm gauges, contains the compound pressure chamber, which is composed of a series of hollow saucer-like disks, B. These hollow disks are put in communication with each other by a central pipe, C. There are two sets of the disk chambers, one set on each side the index centre, and set in reverse directions. In applying the gauge to a steam boiler, the instrument is screwed on to the boiler at D, and as the steam enters by this passage, it finds its way up into all the disk chambers which are beneath the index centre. Passing from the bottom disk, up to the top one of this series, the steam current emerges by the two pipes, E, and passes thence through all the disks above the centre. The entrance pipe at D is fast to the containing case, whilst the upper end pipe, F, is free to move, to accommodate the series of chambers to the internal pressure. The connexion of the several disks, through their central pipe, being

* From the Lond. Pract. Mech. Journal, February, 1855.

by the alternate sides of the disks, a delicately elastic chamber is produced, so that the slightest variation in the internal steam pressure, constantly tending to flatten the external cone surface of one disk, and to bulge still more the internal cone surface of the opposite disk, causes a pretty extensive traverse of the end, F. This end is connected to a cord or fine chain, G, passed over guide pulleys, and thence round the index hand pulley, being finally attached at its opposite end to a reaction helix, H. The pressure is pointed out by the rotary traverse of the index hand upon the graduated edge of the case.

Notice of the Application of the Thistle to the Manufacture of Paper. Patented by Lord Berriedale, London, July 8, 1854.*

Whilst India and other tropical regions have been traversed in search of a plant to be used in place of rags in the paper manufacture, Lord Berriedale has turned his attention nearer home, and has selected the common thistle as the most suitable plant for his purpose. His invention relates to the application and use of the common thistle, or *Carduus,* as it is termed, according to the botanical classification of Linnæus, in the manufacture or production of pulpy material from which paper is to be made, as well as in the manufacture of a fibrous material for textile purposes. All the varieties of the thistle plant are applicable for the purposes of this invention, but more particularly the large Scottish thistle, which grows luxuriantly in many parts of the British islands, attaining a great height and thickness of stem. Such thistles furnish, in each plant, a large amount of long fibre of great tenacity, and which, when duly prepared, is most excellently suited for the preparation of a powerfully cohering paper pulp, as well as for use in textile manufactures.

In adapting the thistle to the manufacture of paper pulp, the plant is used either in a green or dried state. If employed in its natural green condition, it is cut or gathered, and at once beaten or broken up by any suitable mechanism, such as is used in the primary treatment of the flax plant, so as to disintegrate the fibrous or ligneous matter. During this breaking treatment, the mucilaginous and aqueous matter present is washed clear away, either by pure water, or by an acidulous solution, or by any other economical and effective cleansing agent. When the thistle stems are thus fully reduced or disintegrated, the resultant fibrous mass is worked up or macerated in the usual manner, for the production of a pulp suitable for the use of the paper-maker. This pulp may be used in the manufacture of paper, either unmixed, or commingled with other materials already in use for making paper. The routine of manufacture into paper of the pulp, is similar to that pursued with the ordinary rag pulp, or it may be varied, as the properties of the thistle may suggest. The thistle fibre being strong, the paper made from it is of great tenacity, the fibres cohering well together in the paper machine, and being worked up with very little loss from washing away. The fibres are also of good color; hence paper of a fair color may be made from them without bleaching, and if bleaching is resorted to, a very good white color is obtained at a slight expense. The mucilaginous or gummy matter dislodged from the fibres may be collected and applied in the

* From the Lond. Pract. Mechanics' Journ., March, 1855.

manufacture of gum or glutinous matter, or it may be otherwise rendered commercially valuable, so as still further to economize the thistle manufacture. In applying the thistle plant to the manufacture of textile materials, the fibres are primarily prepared in the manner already described, and then subsequently treated according to the existing textile processes —such, for instance, as are adopted in the flax manufacture, the thistle fibre being closely allied to the fibre from the flax plant, as regards its general characteristics. Being strong and of good staple, the thistle fibre is particularly well suited for the spinning and weaving processes.

For the Journal of the Franklin Institute.

Performance of Shawk's Steam Fire Engine.

The engine "Young America," made by Abel Shawk of Cincinnati, was tried a few days since in the yard of the Moyamensing Prison. Owing to the distance of this point from the Water Works, a sufficient quantity of water could not be obtained to supply the pump. Another trial was, therefore, held in Arch street above Tenth, fronting the Presbyterian Church, when the powers of the engine were fully tested and compared with those of the best hand engines in the City.

The peculiarities of this engine may be briefly stated in a description; the boiler consists of a case about $3\frac{1}{2}$ feet and 4 feet to $4\frac{1}{2}$ feet high with arched top, beneath which the fire is made, containing a continuous series of small tubes laid parallel and in close proximity, between which the flames ascend; in connexion with this chamber, and lying horizontally very near the ground, is a cylinder about 10 feet long and $2\frac{1}{2}$ feet diameter divided into two unequal parts by a vertical transverse diaphragm, in the larger of which, near the boiler, is another continuous series of small tubes, the space left around them being connected with the end of the first series of tubes; the other end of this first series, and one end of the second series are in connexion with the force pump. The operation of the boiler is as follows:—Fire is first made and the first series of tubes heated; water being then injected into it becomes instantly converted into steam, which, in traversing its length, becomes highly superheated, and thence entering the cylindrical case, imparts its superfluous heat to the water injected into the second series; and this, being converted into steam, unites with the steam first made, (which has been reduced in temperature nearly to that of saturated steam) and both are admitted to the engine. The use of this arrangement in dividing the tubes, we presume to be convenience in the disposition of the heating surface, while the principle of injecting water into hot surfaces obviates the necessity of carrying large quantities of water, and enables rapid generation of steam. The following results were obtained: Steam formed in 5 minutes 15 seconds after the torch was applied; the water injected was cold. One minute afterwards the gauge showed 15 pounds per square inch, and in 7 minutes 20 seconds after lighting, 50 pounds; at 8 minutes after lighting the pump was put in motion, the steam thereafter rapidly rising to 120 pounds, at which point the safety valve raised while the engine was at work. So far as the operation of the boiler was concerned, the performance was admirable.

We have said that the horizontal cylindrical case was unequally divi-

ded. The smallest part, at the end furthest from the boiler forms the receiving tank for the pump, and is provided with a suction nozzle having eight attachments for hose. On the top of this, is the pump, $7\frac{3}{8}$ inches diameter, and in line with it, towards the boiler, the steam cylinder $11\frac{3}{8}$-inches diameter, both allowing 25 inches stroke of piston and connected by one rod; on which a three armed cross-head is fixed. The two lower arms work the force pumps which are disposed parallel to and alongside of the cylinder. The upper one works a small valve, which admits steam alternately on either end of a small cylinder, to the piston rod of which is affixed the main valve for governing the admission and exit of steam to the main cylinder. The object of this arrangement is to permit the main piston to complete its stroke before reversing its movement. The engine is in fact, a direct double-acting steam pump. Its operation was very satisfactory, and in appearance, finish, &c., unexceptionable.

Its performance in throwing water was as follows:—

Through one $1\frac{1}{8}$ inch nozzle 172 feet horizontal distance (against the wind); 120 feet vertically from the nozzle. Through four $\frac{3}{4}$-inch nozzles about 100 feet. Through 62 feet of hose, one 1 inch nozzle, 176 feet from the end of it or 238 feet from the engine horizontally; through two nozzles one 1 inch and $1\frac{7}{8}$ inch each through 62 feet of hose 103 feet from the nozzle or 165 feet from the engine horizontally. The greatest height thrown by the best hand engine was 2 feet higher *above the nozzle* (which stands 11 feet higher than that of the steam engine,) with a $\frac{7}{8}$-inch nozzle. This was done for a moment only and when fully manned.

On a trial with the suction apparatus attached, drawing water from the Delaware, the performance was as follows:—

Against a moderate breeze, with $1\frac{1}{4}$ inch nozzle, 176 feet horizontally, excluding spray. Through 50 feet hose and same nozzle, 157 feet. Through 325 feet hose and $1\frac{1}{8}$ inch nozzle, 120 feet against, and 151 feet with the wind. Through 685 feet hose and 1 inch nozzle 96 feet with the wind. Through 925 feet hose and $\frac{3}{4}$-inch nozzle stream thrown vertically 40 feet at 70 feet horizontal distance. Pressure of steam carried 96 pounds per square inch.

Mr. Shawk's engine is the best attempt at a steam fire engine we have seen, and is in every way creditable to him as inventor and builder. We hope soon to see more than one of them in use here. No doubt many improvements may and will be made in it. Among others something should be done, if possible, to diminish the noise made, which is very great, on account of the sudden discharge of steam. Perhaps a crank motion may be advantageously introduced. We hope the talents of the engineering profession will be brought to bear on this question, which is one of great practical utility. M.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, May 17th, 1855.

B. Howard Rand, President, pro tem., in the chair.

Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

Donations to the Library were received from the Institute of Actuaries;

The Society of Arts; The Geological Society; and The Royal Institute of British Architects, London; Paul K. Hubbs, Esq., California; James B. Francis, Civ. Eng., Lowell, Mass.; The Young Men's Association, Buffalo, New York; The Pottsville Scientific Association, Pottsville, Penn.; The Trustees of the Girard College for Orphans; The American Medical Association; and Messrs. Edward Miller and B. Howard Rand, Philadelphia.

Donation to the Cabinets, from Edward Miller, Esq.

The Periodicals received in exchange for the Journal of the Institute, were laid on the table.

The Treasurer's statement for April was read.

The Board of Managers and Standing Committees reported their minutes.

Resignations of membership in the Institute by four gentlemen were read and accepted.

The candidates for membership in the Institute, (8,) were proposed, and the candidates proposed at the last meeting, (6,) were duly elected.

A working model of Mr. Thomas Silvers' Patent Marine Governor, was exhibited to the members and explained by Washington Jones.

It is designed to regulate the admission of steam to the engines of steamships. Many plans have been tried to effect this desirable object, but none have been perfectly satisfactory in their action. The ordinary pendulum governor will act, so long as its spindle maintains a vertical position, and the balls are not constrained to revolve in a plane which forms an angle with the horizon; such a condition is obtained, only while the vessel is free from pitching, and when she is so, there is but a comparative small amount of variation in the work to be performed, and consequently, no governor is required. It may be described as an ordinary pendulum governor, with the usual spindle, links, sliding collar, and lever for attachment to the throttle valve, but having the arms prolonged above the joint pins that suspend them to the spindle, until they are of the same length as the par below, and having balls of equal weight upon each end. The balls being in equilibrium, it is evident, will revolve in any plane, no matter what its inclination to the horizon; and also, that as the velocity of revolution diminishes, the balls have no disposition to approach the spindle, the action of gravity being rendered inoperative by the arrangement of the parts. Its function is supplied by a spring coiled around the spindles, and attached to it at one end by a screw and nut to regulate its tension, and connected at the other end by links to the arms. The centrifugal force carrying the balls from the spindle gives a greater amount of tension to the spring, and when the speed slackens, the balls are brought together by the effort of the spring. The model works well, and if proper appliances are used to communicate motion to the practical governor, there is no doubt of its performing equal to the expectations that are entertained of it.

The plan is about to be tested on one of the ocean steamers, and if successful will, most likely, be placed on all of them.

A picture taken by Mr. Mascher's newly discovered process, (described pp. 344 to 347, of this Journal) was sent by him for the inspection of the members. It is a very good specimen of daguerreotyping, all the objects being distinctly shown and well defined.

Mr. G. W. Risdon brought for examination a breech-loading rifle, patented by A. D. Perry, having a self-capping arrangement placed in the stock. The chamber is a rectangular piece of metal, with a continuation upon the lower side of the back end, forming the guard for the trigger, and a lever, whereby the chamber is moved upon a joint pin that passes through it, and two plates, one on either side of the barrel, and the stock at right angles to the trigger. When the trigger guard is moved from the stock, the fore end of the chamber rises to receive the charge; the nipple comes opposite a tube containing caps, one of which is forced outward and upon the nipple and is carried up when the chamber is returned to its place. The recoil does not come upon the joint pin, but on the shoulder at the back end of the chamber, that, as well as the muzzle end, being rounded to a circle described from the centre of the pin, and being a very neat fit when in its place, ready for firing.

Mr. H. Howson exhibited a very complete working model of an apparatus for removing and replacing the wheels of locomotives and cars, the invention of Mr. John Fouser, of this city. The locomotive or car is moved on to a platform, which is on a level with the track, and which is arranged so as to be raised or lowered in a pit by means of a series of screws operating within stationary columns secured to the masonry, which forms the walls of the pit. The screws are connected by means of double jointed rods to the ends of strong cross bars underneath the movable platform.

On the tops of the columns are worm wheels, secured to the nuts of the perpendicular screws, and into these wheels gear a corresponding number of worms on longitudinal shafts. These shafts may be operated by hand or by belts from any adjacent power. On the locomotive or car being placed on the platform, adjustable levers are placed with their points under the frame of the locomotive, under the edge of the fire-box, or other stationary portion of the engine, the weight of which rests on the levers. The platform is now lowered, and with it the wheels and axles, until sufficiently low to enable the wheels to be rolled clear of the engine, when the platform is again raised to a level with the track, along which the wheels may be removed to any distance required.

Mr. Howson remarked, that the inventor calculates the cost of the machine at from eight to twelve-hundred dollars, according to the size, and that by its assistance and the work of two attendants only, the whole of the wheels of a large locomotive can be removed and replaced in less than one hour.

The model is now on exhibition at 6, Forrest Place, 55 South Fourth Street, Philadelphia.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on Mr. Tasker's Self-Regulating Water Furnace.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, "a Self-Regulating Water Furnace," invented by Mr. Thomas T. Tasker, of Philadelphia, Pennsylvania—Report:

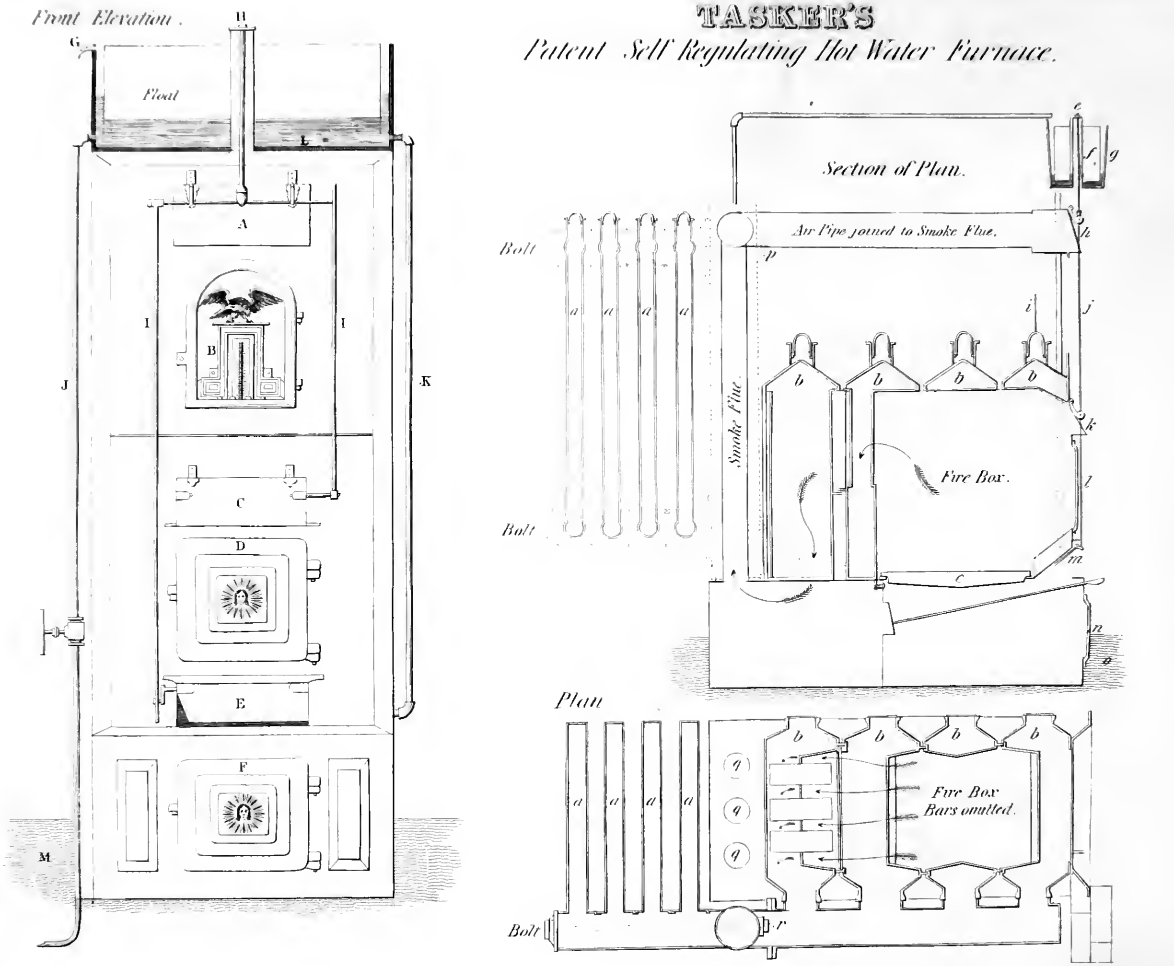
That the furnace of Mr. Tasker is arranged to warm buildings by means of air which has passed over pipes, within which hot water is

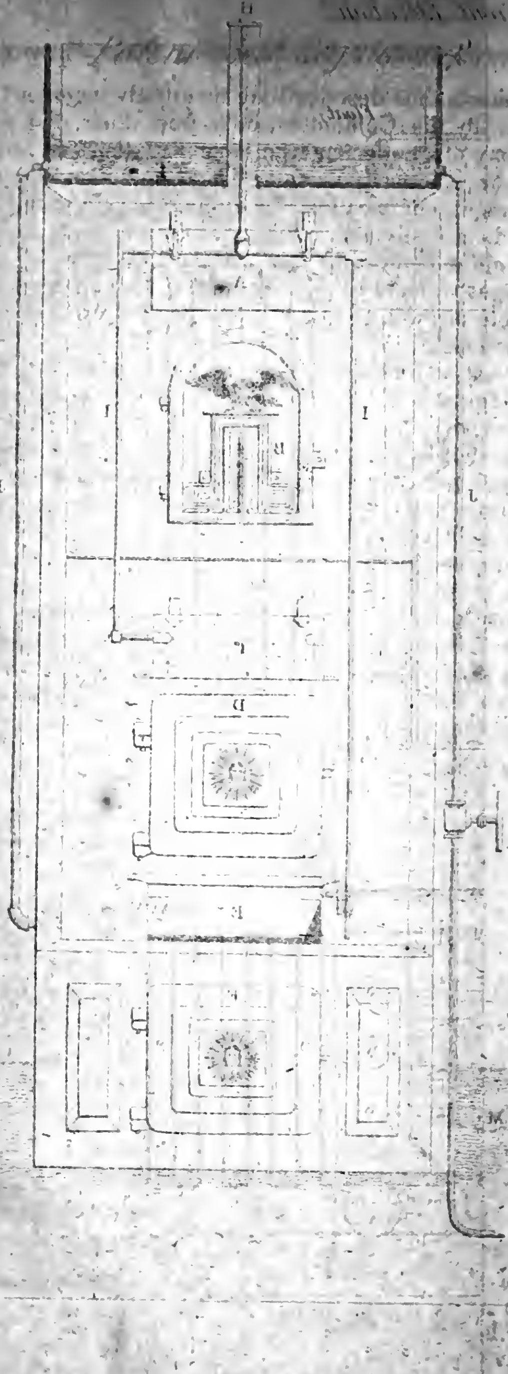
circulating; and the peculiarities consist partly in the novel construction of the furnace itself, and of the sets of water pipes communicating with it, so as to allow them to be economically cast, and easily and speedily put together, and chiefly in a self-acting means of controlling the draft of the furnace, so regulating the heat as to insure economy, and dispense with the necessity of frequently meddling with the fire. The furnace has the usual grate bars and ash pit below, but the sides and top consist of water spaces cast in segments fitting into each other, and to be made air-tight by proper cement. The peculiar form of these segments can be best seen by inspection of the accompanying drawing, (Plate III.) The general figure is that of a small frustrum of a double pyramid, cast with projections on one face, and corresponding recesses in the other, so as to permit them to be tightly fitted together. At the upper part of each side, they communicate with the main tube for the hot water, and at the lower part with the return tube for the water, after it has made its circuit. The water flues, around which the air to be heated, circulates, are also cast in sections, called by Mr. Tasker manifolds, each section consisting of a number (in the model 7,) of tubes connected at the top and bottom by tubes of larger diameter. Each of these sections can be easily cast in one piece, and the number of joints to be kept close is thus much diminished. The ends of each connecting tube terminate in rings cast on them, which rings, when the sections are set up, fit into each other by projections and grooves, so as to form one continuous pipe, which is a continuation of one of the carrying or return water pipes of the furnace; and, when adjusted and cemented, a single bolt passing through the axis of each pipe, binds all the sections tightly together, yet allows them to be easily and rapidly separated.

It need scarcely be remarked that, when it is desired, the water pipes may be continued throughout a building, so as to heat directly by the radiation from the water pipes.

But the principal feature of novelty about the apparatus is the self-governing valve. This consists of a float in a reservoir, so placed on the apparatus as to have the level of the water within it affected by the expansion of the water by heat, and its contraction as it cools. From this float a rod passes downwards and governs a register in a flue, by which, when open, air is admitted directly to the chimney. The draft door of the furnace is also closed by a register, so connected by a rod with that just described, that as the one opens, the other closes. So that as the water becomes too hot, its expansion lifts the float, and by its rod lessens the draft, both by letting the air directly into the chimney, and by tightly closing the draft door. The first register is, moreover, connected by means of a slotted rod, with another register in a flue admitting air to enter over the surface of the fire. Thus, when the cooling action begins, it is effected by the two flues first described, the last remaining inactive while the chimney register opens considerably, owing to the slot which allows the pin to rise without affecting the rod. But should the heat continue to increase so as to lift the chimney valve above a certain angle, the pin lifts the rod which operates on the last register, and the two thereafter lifting together, the temperature of the fire is speedily checked by the additional dampening of the draft through the fuel.

TASKER'S
Patent Self Regulating Hot Water Furnace.





... valve above a
... ast register, and
... fire is speedil
... the fuel.

The arrangements thus described are manifestly ingenious and simple, and they appear to the Committee, both from their own examination, and the testimony of gentlemen who have had them in operation on a large scale, to be practically useful. The Committee would especially notice the ingenious combinations for diminishing the number of joints, and rendering them easily and rapidly accessible, while the parts are so arranged as to allow them to be cast without difficulty.

The advantages claimed by Mr. Tasker for his apparatus are :

1st, A reliable method of controlling the fire without attention, for twelve hours or longer.

2d, A sufficient and uniform heat, without the possibility of producing a temperature injurious to the health, or unpleasant to the senses.

3d, The greatest economy in fuel and labor, the combustion being effectually regulated by the action of the water in the apparatus upon the valves, under and over the fire, and in the smoke flue.

4th, Safety from fire. The fire being entirely surrounded by water, circulating at a temperature below the boiling point.

5th, The improved method of combining the several parts, making but few joints, and these always accessible.

The apparatus is, of course, much more expensive at first, than an ordinary hot air furnace, but as it presents peculiar advantages, and is free from many disadvantages to which these are subject, every one must determine, in his own peculiar case, whether the increased regularity, safety, and economy of fuel and labor, will justify the additional expenditure.

REFERENCE TO PLATE III.

Front Elevation.

A, Valve opening smoke flue.
B, Mercury gauge.
C, Valve opening over fire.
D, Fire door.
E, Valve opening under fire.
F, Ash pit door.
G, Overflow pipe.
H, Rod connecting the float to all the valves.
I I, Valve rods.
J, Supply pipe.
K, Pipe connecting furnace to reservoir.
L, Reservoir—front left off.
M, Cellar floor.

PLAN.—*a a a a*, Radiating manifolds.
9 9 9, Smoke.
r, Bolt connecting manifold.
6 6 6 6, Cast iron tubular sections.

a a a a, Radiating manifolds.
b b b b, Cast iron tubular sections.
c, Fire bars.
d, Dust flue.
e, Rod connecting the float to all the valves.
f, Float.
g, Reservoir.
h, Valve opening into smoke flue.
i, Mercury gauge.
j, Valve rod.
k, Valve opening over fire.
l, Fire door.
m, Valve opening under fire.
n, Ash pit door.
o, Cellar floor.
p, Bolt passing through the several manifolds, by which all the joints are screwed up to tightness.

By order of the Committee,

WM. HAMILTON, *Actuary.*

Philadelphia, March 8th, 1855.

BIBLIOGRAPHICAL NOTICE.

Lowell Hydraulic Experiments, being a Selection from Experiments on Hydraulic Motors, on the Flow of Water over Weirs and in Canals of uniform Rectangular Section and of Short Length, made at Lowell, Massachusetts. By JAMES B. FRANCIS, Civ. Eng., &c.

The author of this work has had opportunities remarkably favorable for making experiments on a large scale through the liberality of the Manufacturing Companies of Lowell. No pains or expense appear to have been spared, and this work, embodying a part of the results, is a most valuable contribution to Hydraulic literature. The volume is a large quarto, well printed upon good paper, and fully illustrated by fifteen well executed folio plates, giving accurate drawings of the wheels submitted to experiment and of the apparatus used in making the investigations. The work is divided into two parts; the first is on hydraulic motors, and contains descriptions of the wheels upon which the experiments were made, tabulated results of the experiments, and practical instructions for proportioning Turbine water wheels. The second part treats of the flow of water over weirs, and on short rectangular canals, and gives an account of a series of experiments made upon a magnificent scale and with extreme precautions to insure accuracy.

The whole work is most creditable in every respect, and is commended to the notice of all interested in the science of hydraulics as a most valuable and important addition to this branch of knowledge. T.

The Quarterly Journal of Pure and Applied Mathematics, edited by J. J. SYLVESTER, M.A., F.R.S., and N. M. FERRES, M.A., assisted by G. G. STOKES, M.A., F.R.S., A. CAYLEY, M.A., F.R.S., and M. HERMITE. London: Published by J. W. PARKER & SON, West Strand, London.

The first number of a periodical bearing the above title, has reached us. It is (typographically) well got up, and from the character of the gentlemen who are associated in its editorial management, will, no doubt, prove a valuable exponent of the science on which it treats. M.

ERRATA.

Page	307—	Equation	(18)	for	$y=2-4^{-1}b'$	read	$y=z-4^{-1}b'$.
“	“	“	(19)	“	$2^4+p\,2^2+q\,2$	“	$z+p\,z+q\,z=r$.
“	“	“	(20)	“	$2=s+t$	“	$z=s+t$
“	308	“	(22)	“	$3^2=-(t^2$ &c.	“	$s^2=-(t^2$ &c.
“	“	“	(23)	“	$s^4+3^2(6\,t^2$ &c.	“	$s^4+s^2(6\,t^2$ &c.
“	“	“	(28)	“	$u=2^1-3^{-1}m$—	“	$u=z'-3^{-\prime}m$
“	“	“	(29)	“	$2'^3+p'\,2'=r'$	“	$z'^3+p\,z'=r'$
“	“	“	(31)	“	$2'=s'+t'$	“	$z'=s'+t'$

“ 309 line 18 and 14 from bottom, for 70, read >0.

“ “ “ 14 from bottom, for 7*c* read $\succ 0$.

INDEX.

LIST OF AMERICAN PATENTS, WITH REMARKS, &c.

RE-ISSUE.

DESIGN.

January, 1855.

ADDITIONAL IMPROVEMENT.

RE-ISSUES.

DESIGNS.